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TM 5-4320-220-15

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

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**OPERATOR, ORGANIZATIONAL, FIELD
AND DEPOT MAINTENANCE MANUAL**

PUMP, CENTRIFUGAL:

**GASOLINE DRIVEN; BASE MTD; 2 IN.;
166 GPM, 25 FT HEAD (BARNES MODEL
10-MG) SERIAL NUMBER 1 THROUGH 207,
FSN 4320-820-0700**

**HEADQUARTERS, DEPARTMENT OF THE ARMY
10 JULY 1961**

SAFETY PRECAUTIONS

BEFORE OPERATION

Be sure the centrifugal pump has proper exhaust connection to the outside before operation in an enclosed area. Exhaust gases contain carbon monoxide, which is a colorless, odorless, and poisonous gas.

When filling the fuel tank, always provide a metal-to-metal contact between the fuel container and the fuel tank. This contact will prevent a spark from being generated as gasoline flows over the metallic surfaces.

Be extremely careful when using a carbon tetrachloride type fire extinguisher in an enclosed area. A poisonous gas is generated by the contact of carbon tetrachloride with a heated metallic surface. Provide adequate ventilation before entering an enclosed area where carbon tetrachloride is used.

DURING OPERATION

Do not remove guards, shields, or screens to perform services or maintenance work while the unit is operating.

Do not fill the fuel tank while the unit is in operation. Gasoline spilled on a hot engine may explode and cause serious injury to personnel.

Be extremely careful when using a carbon tetrachloride fire extinguisher in an enclosed area. A poisonous gas is generated by the contact of carbon tetrachloride with a heated metallic surface. Provide adequate ventilation before entering an enclosed area where carbon tetrachloride is used.

AFTER OPERATION

Make sure the spark plug is disconnected before doing any work on the centrifugal pump.

When filling the fuel tank, always provide a metal-to-metal contact between the fuel container and the fuel tank. This contact will prevent a spark from being generated as gasoline flows over the metallic surfaces.

Be extremely careful when using a carbon tetrachloride type fire extinguisher in an enclosed area. A poisonous gas is generated by the contact of carbon tetrachloride with a heated metallic surface. Provide adequate ventilation before entering an enclosed area where carbon tetrachloride is used.

TECHNICAL MANUAL

No. 5-4320-220-15

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON 25, D.C., 10 July 1961

Operator, Organizational, Field and Depot Maintenance Manual

PUMP, CENTRIFUGAL: GASOLINE DRIVEN; BASE; MTD; 2 IN.;

166 GPM, 25 FT HEAD (BARNES MODEL 10-MG) SERIAL

NUMBER 1 THROUGH 207, FSN 4320-820-0700

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the use of personnel to whom the Barnes Centrifugal pump, Model 10-MG, is issued. Chapters 1 through 5 provide information on the operation, lubrication, daily preventive maintenance service, and organizational maintenance of the equipment, accessories, components, and attachments. Chapter 6 provides information for field and depot maintenance of the equipment. This manual also provides a description of main units and their function in relationship to other components.

b. Appendix I contains a list of publications applicable to this manual. Appendix II contains the Maintenance Allocation Chart. Appendix III contains a list of the basic issue items authorized for use of the operator of this equipment. The Organizational, Field, and Depot Maintenance Repair Parts and Special Tool Lists are in TM 5-4320-220-25P.

c. Numbers in parentheses on illustrations indicate quantity. Numbers preceding nomenclature callouts on illustrations indicate the preferred maintenance sequence.

d. Report all deficiencies in this manual on DA Form 2028. Submit recommendations for changes, additions, or deletions to the Commanding General, Military Construction Supply Agency/U.S. Army Engineer Maintenance Center, Corps of Engineers, ATTN: EMCM, P.O. Box 119, Columbus 16, Ohio. Direct communication is authorized.

2. Operator and Organizational Maintenance Record and Report Forms

a. Da Form 2258 (Depreservation Guide of Engineer Equipment).

b. For other record and report forms applicable to the first and second echelons of maintenance, refer to TM 5-505, Maintenance of Engineer Equipment.

Section II. DESCRIPTION AND DATA

3. Description

a. *General.* The Barnes Centrifugal Pump, Model 10-MG (figs. 1 and 2), mounted on two base rails (fig. 2), is a portable, self-contained unit. It is powered by a one-cylinder gasoline engine (fig. 1) that is directly coupled to the pump (fig. 2) with all controls and indicators necessary for normal operation.

b. *Engine.* The Wisconsin Engine, Model MAENLD (fig. 1), which powers the centrifugal pump, is an air-cooled, single-cylinder, 4-cycle gasoline engine developing 6.1 hp (horsepower) at 3,600 rpm (revolutions per minute). Fuel is furnished by a float-type carburetor bolted to the cylinder crankcase. Ignition is furnished by a magneto with an impulse coupling to supply a powerful spark

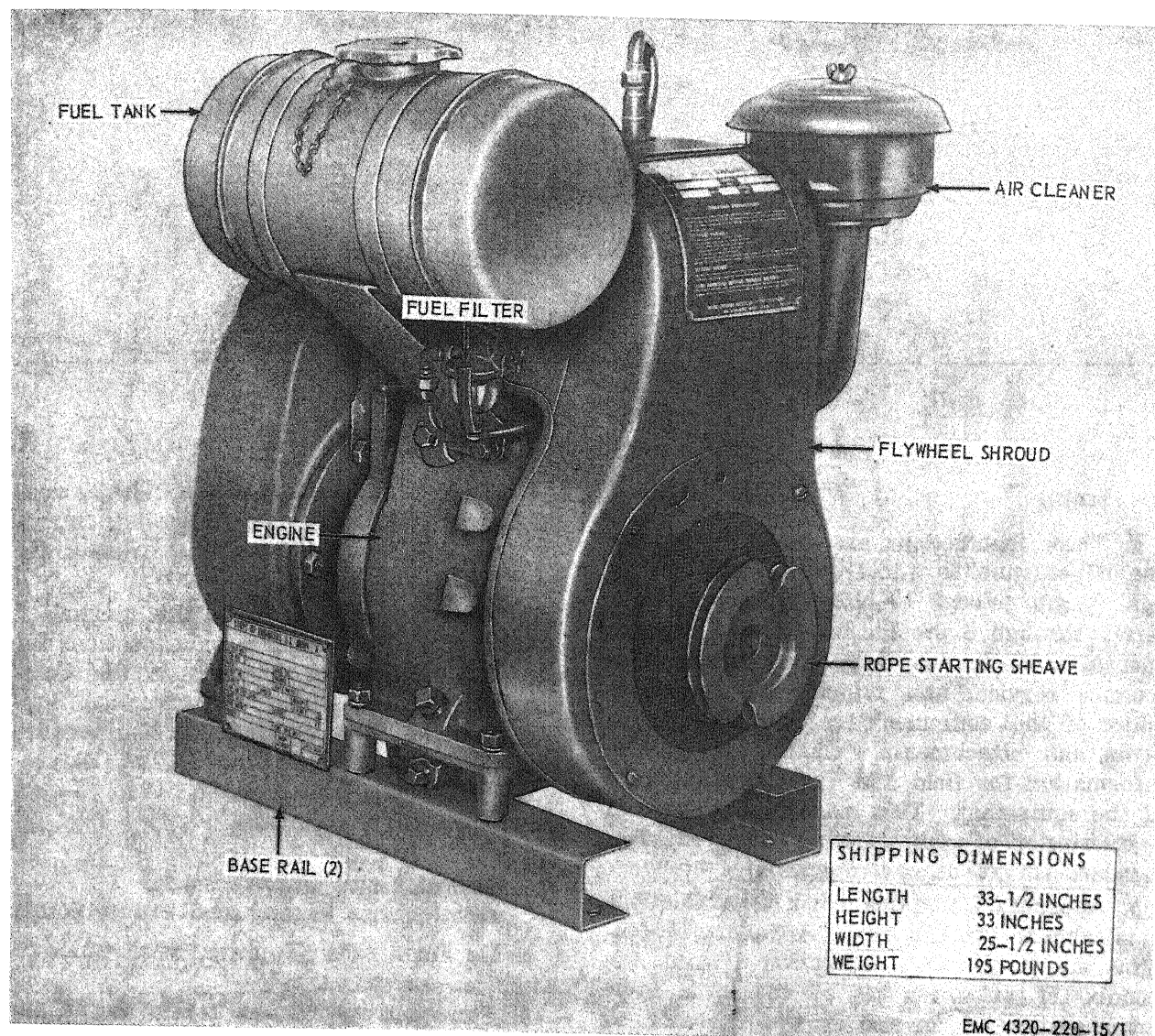


Figure 1. Centrifugal pump, right front three-quarter view.

for easy starting. Exhaust gases are piped to the outside of the unit through a muffler (fig. 1). A flow of air is forced to circulate through the flywheel shroud and around the cylinder crankcase fins to cool the engine.

c. *Centrifugal Pump.* The Barnes Centrifugal Pump, Model 10-MG, is a 2-inch water pump rated at 166 gpm (gallons per minute) at 25 foot-head. It is directly coupled to the engine (fig. 1).

4. Identification

The centrifugal pump has two identification plates. The Corps of Engineers Plate is

located on the base rail on the right side of the unit and the engine plate is located on the air shroud covering the flywheel. The data on these plates are contained in tabulated data (par. 6).

5. Differences in Models

This manual covers only the Barnes Manufacturing Company Centrifugal Pump, Model 10-MG, serial numbers 1 through 207. No known unit differences exist for the model covered in this manual.

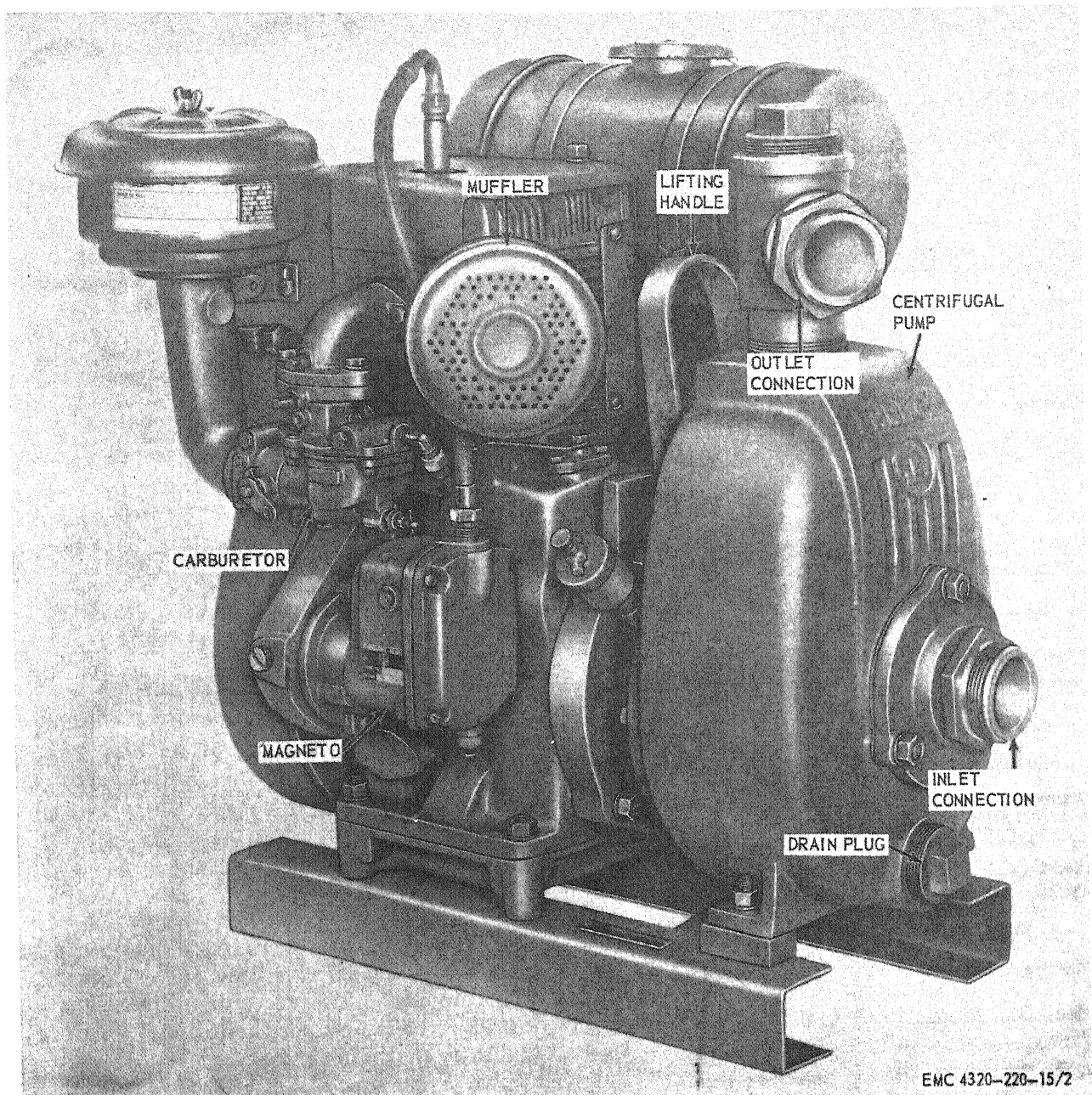


Figure 2. Centrifugal pump, left rear three-quarter view, with shipping dimensions.

6. Operator and Organizational Maintenance Tabulated Data

a. General.

Manufacturer ----- Barnes Manufacturing Company
Model ----- 10-MG
Type ----- Portable, gasoline-driven
Nomenclature ----- Pump, centrifugal, water, 166 gpm

b. Engine.

Manufacturer ----- Wisconsin Motor Corporation
Model ----- MAENLD
Type ----- L-head air-cooled
Number of cylinders ----- 1
Cycle ----- 4
Cylinder ----- 3 in. (inch)
Ignition ----- Magneto

Cranking method ----- Rope starting sheave
Stroke ----- 3 1/4 in.
Cooling ----- Forced air
Horsepower ----- 6.1 at 3,600 rpm
Rated governed speed with
load ----- 2,625 rpm
Piston displacement ----- 23 cu in. (cubic inch)

c. Corps of Engineers Identification Plate.

Nomenclature ----- Pump, centrifugal, power
driven
Stock number ----- 4320-820-0700
Make ----- Barnes Manufacturing Com-
pany
Model ----- 10-MG
Serial number -----
Date manufactured -----
Contract number ----- DA 33-181-ENG-239

d. Wisconsin Motor Corporation Identification Plate.

Manufacturer ----- Wisconsin Motor Corpora-
tion
Model ----- MAENLD
Serial number -----
Size ----- 3 x 3 1/4 in.
Specification number ----- 189294

e. Centrifugal Pump.

Manufacturer ----- Barnes Manufacturing Com-
pany
Model ----- 10-MG

f. Carburetor.

Manufacturer ----- Zenith Carburetor Division
of Bendix Aviation Cor-
poration
Model ----- 68-7
Type ----- Updraft

g. Fuel Strainer.

Manufacturer ----- Crippen Machine and Tool
Model ----- 830
Type ----- Standard

h. Governor.

Manufacturer ----- Wisconsin Motor Corpora-
tion
Model ----- T-98-E
Type ----- Flyweight

i. Engine Air Cleaner.

Manufacturer ----- United Specialties Corpora-
tion
Model ----- T-12-B1
Type ----- Oil bath

j. Magneto.

Manufacturer ----- Fairbanks Morse Company
Type ----- FM-XDE 1B7A
Drive ----- Gear

k. Spark Plug.

Manufacturer ----- Champion Manufacturing
Corporation
Model ----- XED-16
Type ----- 64 K
Size ----- 18 mm (millimeter)

l. Adjustment Data.

Spark plug gap ----- 0.030 in.
Magneto breaker point sep-
aration ----- 0.015 in.
Valve lifter (intake and ex-
haust -----
Engine cold (intake) ----- 0.008 in.
Engine cold (exhaust) ----- 0.016 in.

m. Capacities.

Engine crankcase ----- 1-1/2 qt (quart)
Engine air cleaner ----- 3/16 qt
Fuel tank ----- 1-1/2 gal (gallon)

n. Maintenance and Operating Supplies.

Table I provides a listing of all oils, grease, and gasoline required for the initial operation.

o. Dimensions and Weight.

Length ----- 33-1/2 in.
Width ----- 25-1/2 in.
Height ----- 33 in.
Weight ----- 195 lb (pound)

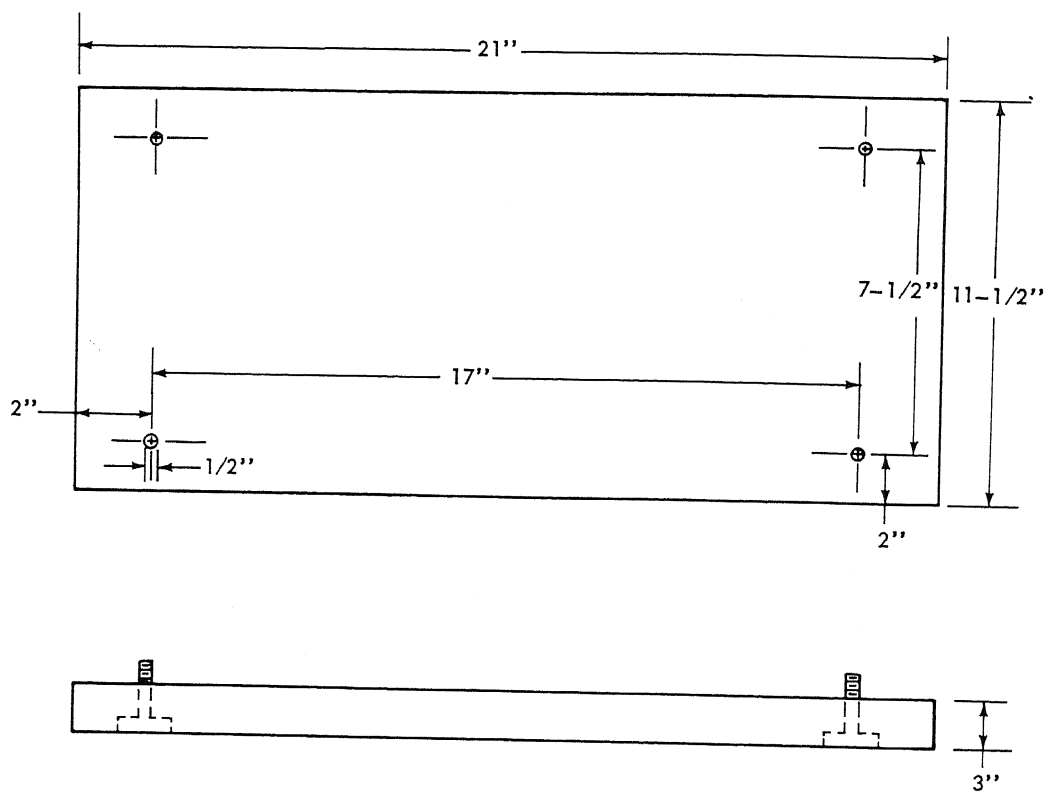
p. Base Plan. The centrifugal pump can be installed on any suitable base, such as concrete, wood, or steel. The necessary dimensions for installing bolts and positioning the centrifugal pump are shown in figure 3.

q. Nut and Bolt Torque Data.

Engine cylinder head
screws and nut ----- 32 ft-lb (foot-pound)
Engine intake manifold ----- 9 ft-lb
Engine spark plug ----- 24 to 26 ft-lb

Table I. Maintenance and Operating Supplies

Item	Component application	Source of supply	Federal stock no.	Description	Quantity required for 8 hours operation	Quantity required for initial operation	Notes
1	0101 CRANK-CASE (1)	10	9150-265-9433 (2)	LUBRICATION OIL: 1 qt cans as follows: OE30 or 9250 oil (2)	1 11/16 qt (3)		(1) Includes quantity of oil to fill engine oil system as follows: 1 1/2 qt crankcase 3/16 qt air cleaner
2	0304 AIR CLEANER (4)	10	9150-265-9425 (2)	OE10 or 9110 oil (2)	1 11/16 qt (3)		(2) See SM 10-1-C4-1 for additional data and requisitioning procedure.
3	0306 FUEL TANK	10	9150-242-7602 (2)	OES oil Subzero (2)	1 11/16 qt (3)		(3) See the current lubrication order for grade application and replenishment intervals.
4	5500 PUMP	10	9130-160-1817 (2)	GASOLINE AUTOMOTIVE combat 91A 5-gal can	1 1/2 gal (5)	5 1/2 gal (6)	(4) Use oil as prescribed in item 1 above. (5) Tank capacity. (6) Average fuel consumption is 0.68 gal per hour of continuous operation.
		10	9150-190-0904 (2)	GREASE AUTOMOTIVE AND ARTILLERY GAA 1-lb can	As required	As required	



EMC 4320-220-15/3

Figure 3. Base plan.

CHAPTER 2

INSTALLATION AND OPERATION INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

7. Unloading Equipment

The centrifugal pump is shipped as a complete unit in a reinforced crate which holds the unit securely in a fixed position. A fork-lift truck, pipe rollers, or other handling equipment may be used to remove the unit from the carrier.

8. Unpacking Equipment

a. Place the centrifugal pump as near the point of installation as possible. Remove the nails holding the cover to the crate and remove the cover. Remove the inside end braces on both ends of the crate.

Note. Do not drive a crowbar into the crate. This may result in damage to the equipment.

b. Lift the centrifugal pump clear of the crate by means of a sling or by manpower.

c. Prepare equipment for inspection and operation as outlined on DA Form 2258, attached on or near the operational controls.

9. Inspection of New and Used Equipment

a. Perform the preventive maintenance services (par. 32).

b. Inspect the entire centrifugal pump for loss or damage which may have occurred during shipment.

c. Inspect the fuel line, spark plug cable, and fittings to see that they are secure and free of breaks, kinks, and other damage.

d. Inspect the engine accessories for damage and insecure mountings.

e. With the ignition cable disconnected, manually turn the engine starting sheave to

insure free movement of the crankshaft, connecting rod, piston, and bearings.

f. Tighten loose fittings, bolts, nuts, or screws and replace missing parts.

10. Installation or Setting-Up Instructions

a. This centrifugal pump is a portable unit designed to operate satisfactorily on any level surface. Locate the unit as near as possible to the source of supply. It may be installed indoors or outdoors, with temporary or permanent mounting. Position the unit on any reasonable level surface and bolt it to a stable wooden or concrete base.

b. Ample space must be provided on all sides of the centrifugal pump to afford adequate ventilation and working area for starting and servicing the unit.

c. Connect suitable hoses to the suction and discharge flange adapters.

d. The suction and discharge line diameters should never be less than the diameter of their respective pump connections. They should possibly be one or two sizes larger, based on friction loss incurred, due to pipe and fittings in the lines. The suction and discharge lines should be supported securely when attached to the pump.

11. Servicing New and Used Equipment

a. *Servicing.* Service the centrifugal pump as directed in paragraph 30.

b. *Lubrication.* Lubricate the centrifugal pump as specified in the current lubrication order.

c. *Fuel System.* Refer to Table I and fill the gasoline tank with the proper grade of gasoline and inspect for leaks.

Warning: When filling the fuel tank, always provide a metal-to-metal contact between the fuel container and fuel tank. This contact will prevent a spark from being generated as gaso-

line flows over the metallic surfaces.

Warning: Be sure that centrifugal pump has a proper exhaust connection to the outside before operation in an enclosed area. Exhaust gases contain carbon monoxide, which is a colorless odorless, and poisonous gas.

Section II. MOVEMENT TO A NEW WORKSITE

12. Dismantling for Movement

a. Disconnect the hoses from the suction and discharge flange adapters.

b. Cover the suction and discharge flange adapters to protect the threads and to prevent foreign material from entering the pump.

c. Disconnect the outside exhaust piping if used.

13. Reinstallation After Movement to a New Worksite

For reinstallation of the centrifugal pump after movement to a new worksite, refer to paragraph 10.

Section III. CONTROLS AND OPERATION UNDER USUAL CONDITIONS

14. Controls

The purpose and positions of all controls will be found in figure 4.

15. Operation Under Usual Conditions

The operator must know how to operate the centrifugal pump. Paragraphs 16 through 18 contain instructions on engine starting, engine stopping, and the operating details of the centrifugal pump.

16. Engine Starting Instructions

a. *Preparation for Starting.*

- (1) Perform the before-operation services (par. 30).
- (2) Prime the pump as described in figure 5, if the pump body is not full of water.

b. *Starting.* Start the engine as shown by figure 6.

Note: Allow engine to reach operating temperature before starting pumping operations.

Caution: Do not operate the pump for long periods without water running through it. Running the pump in a dry condition may damage the seal.

17. Engine Stopping Instructions

Stop the engine as shown by figure 7.

18. Operating Details

a. Attach the suction and discharge lines to the appropriate flange adapters on the centrifugal pump (fig. 2).

b. Start the engine (par. 16).

c. Proceed with the desired operation of the unit and perform the during-operation services (par. 30).

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

19. Operation in Extreme Cold (Below 0°F)

a. *General.* Operation of the centrifugal pump under extreme cold conditions presents problems that demand special precautions and care in servicing the unit.

b. *Fuel System.* In cold temperatures, condensation of moisture will cause water to accumulate in the fuel system. This water will

freeze and form ice crystals. Take the following precautions to prevent these crystals from clogging the fuel system:

- (1) Remove the snow and ice from the fuel tank cap prior to filling the tank and keep the tank full at all times.

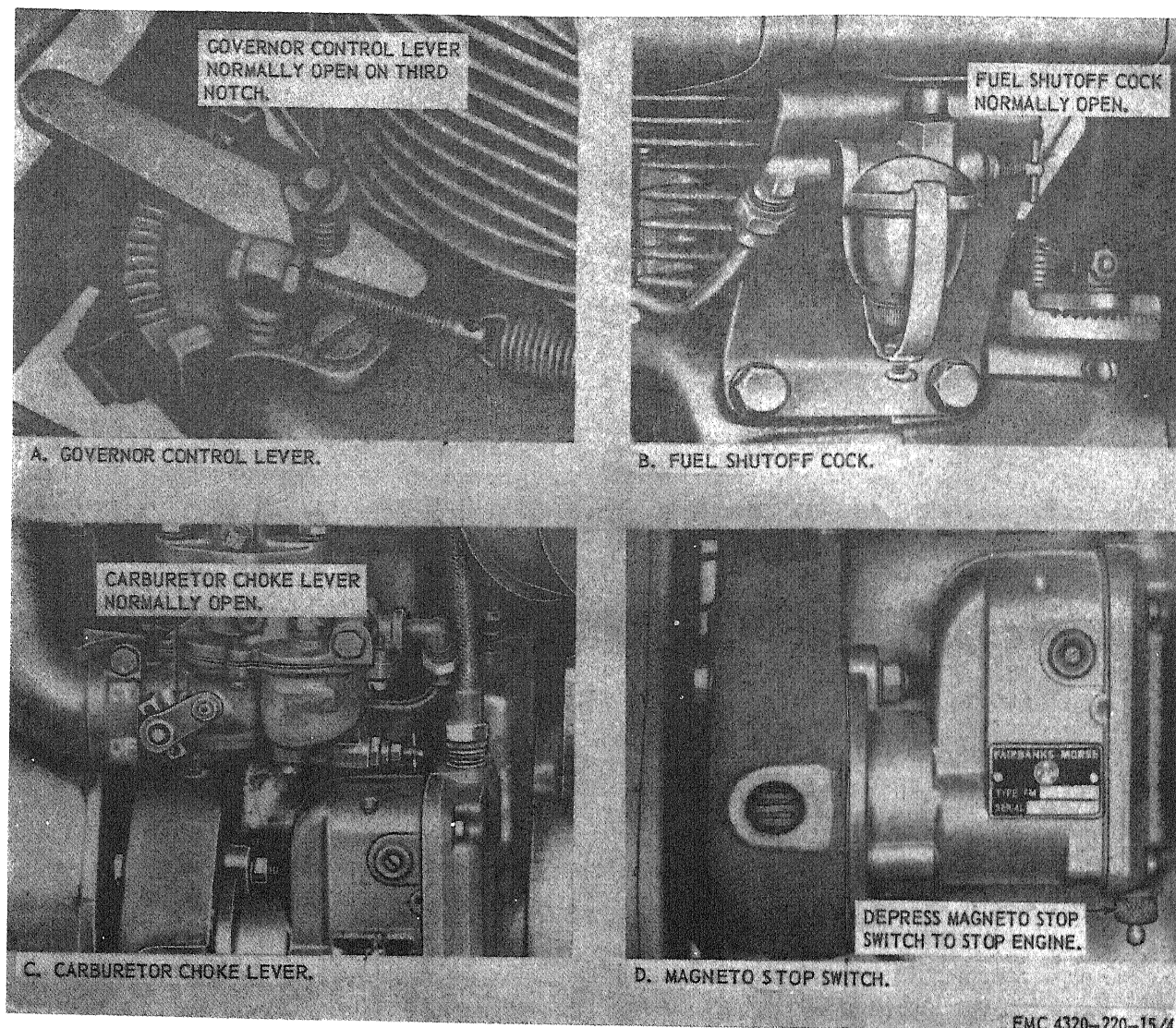


Figure 4. Controls.

- (2) Keep the fuel tank cap tight to prevent moisture and dirt from entering the tank.
- (3) Service the fuel strainer more frequently than during normal operation (par. 54).

c. Ignition System. In cold weather, be sure the spark plug is kept clean and free from moisture. Remove ice and snow from the spark plug, magneto, and cable. See that the ignition connections are clean and tight. Since the insulation on the cable tends to become brittle at low temperatures, avoid excessive

handling and sharp bending.

d. Lubrication.

- (1) Lubricate the engine and pump in accordance with the cold weather instructions in the current lubrication order.
- (2) Service the air cleaner more frequently than during normal operation (par. 59).

e. Centrifugal Pump.

- (1) To avoid freezing, drain the pump when the flow of water is halted.

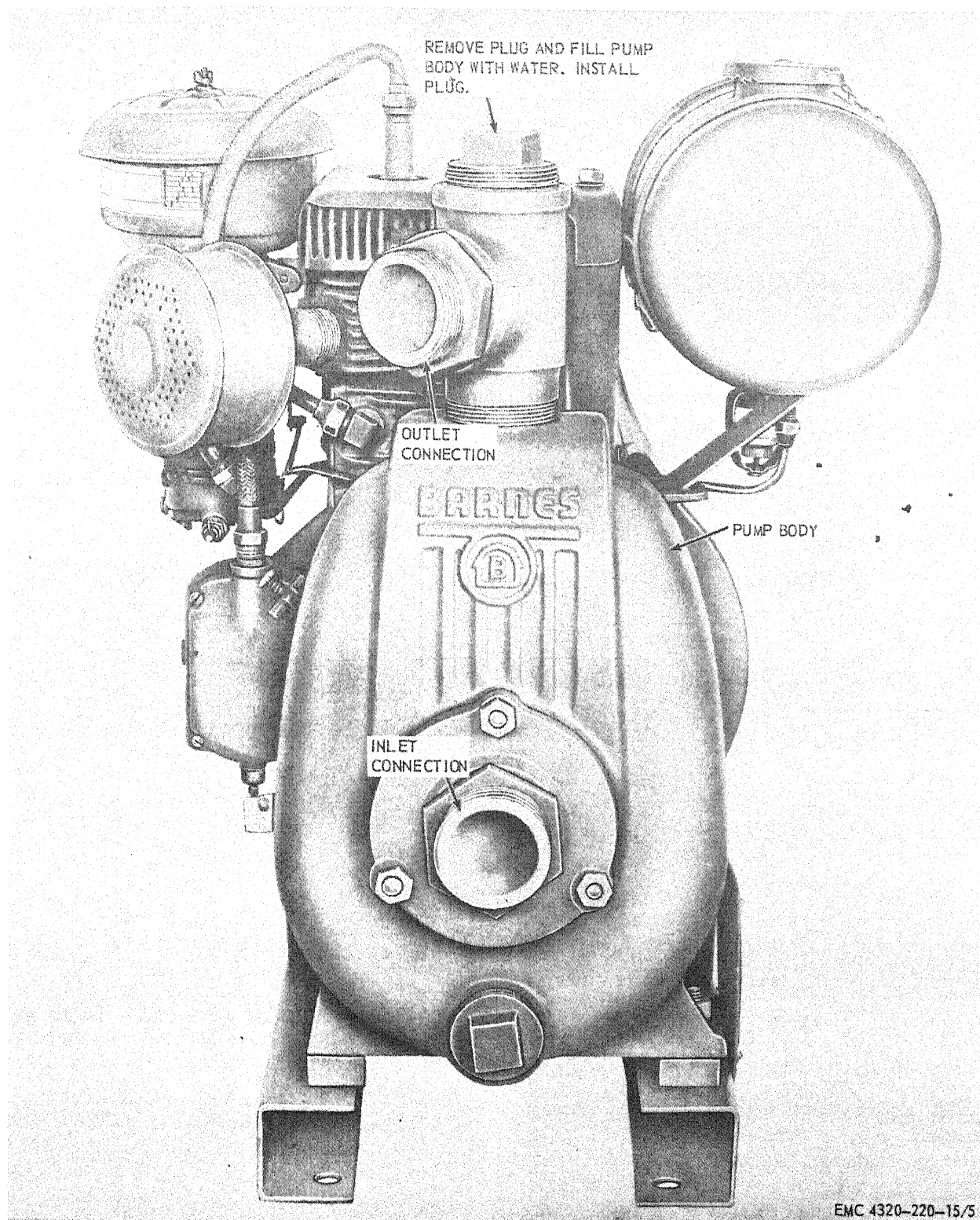
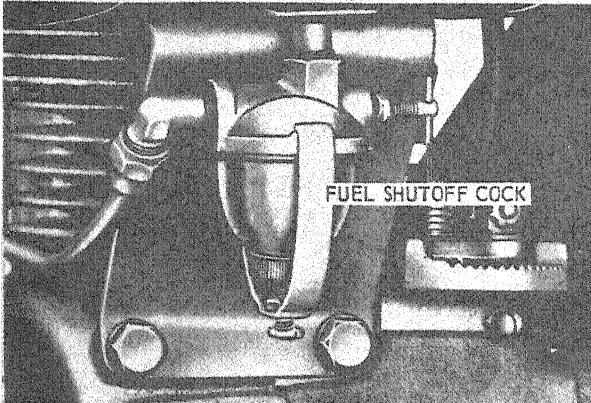
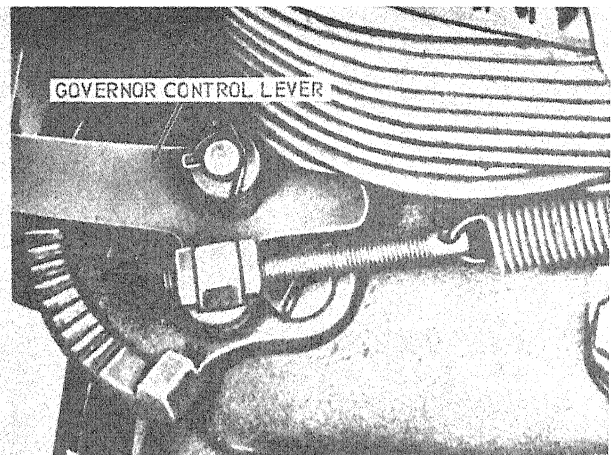


Figure 5. Pump priming instructions.

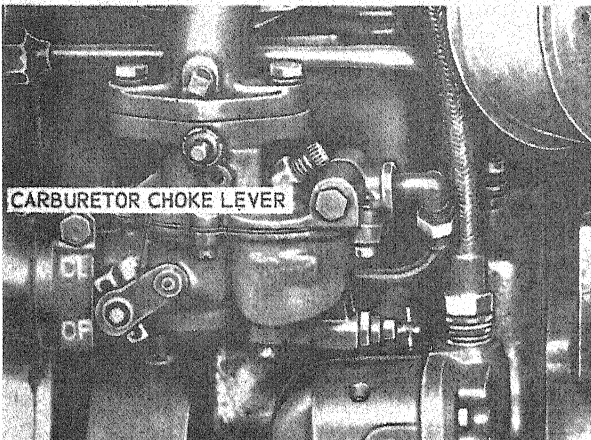
NOTE: PERFORM ALL BEFORE-OPERATION SERVICES PRIOR TO STARTING ENGINE.



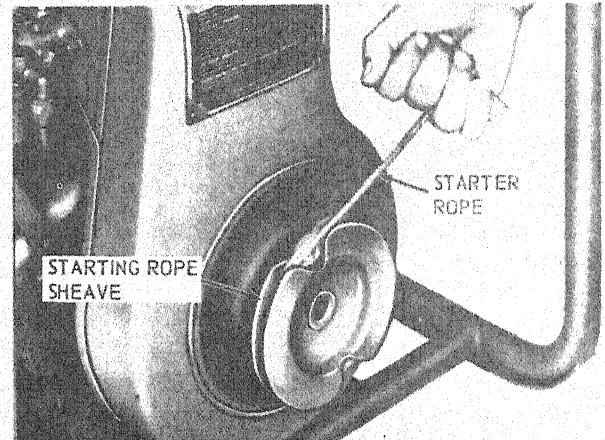
STEP 1. OPEN FUEL SHUTOFF COCK.



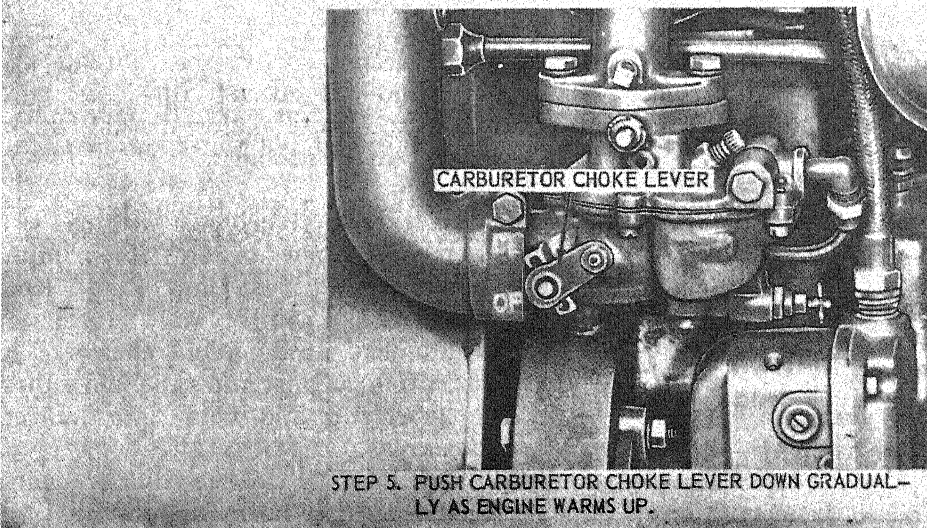
STEP 2. SET GOVERNOR CONTROL LEVER THREE NOTCHES BACK FROM MAXIMUM POSITION.



STEP 3. PUSH CARBURETOR CHOKE LEVER UP TO CLOSE CHOKE.



STEP 4. WRAP STARTER ROPE AROUND STARTING ROPE SHEAVE AND PULL.



STEP 5. PUSH CARBURETOR CHOKE LEVER DOWN GRADUALLY AS ENGINE WARMS UP.

EMC 4320-220-15/6

Figure 6. Engine starting instructions.

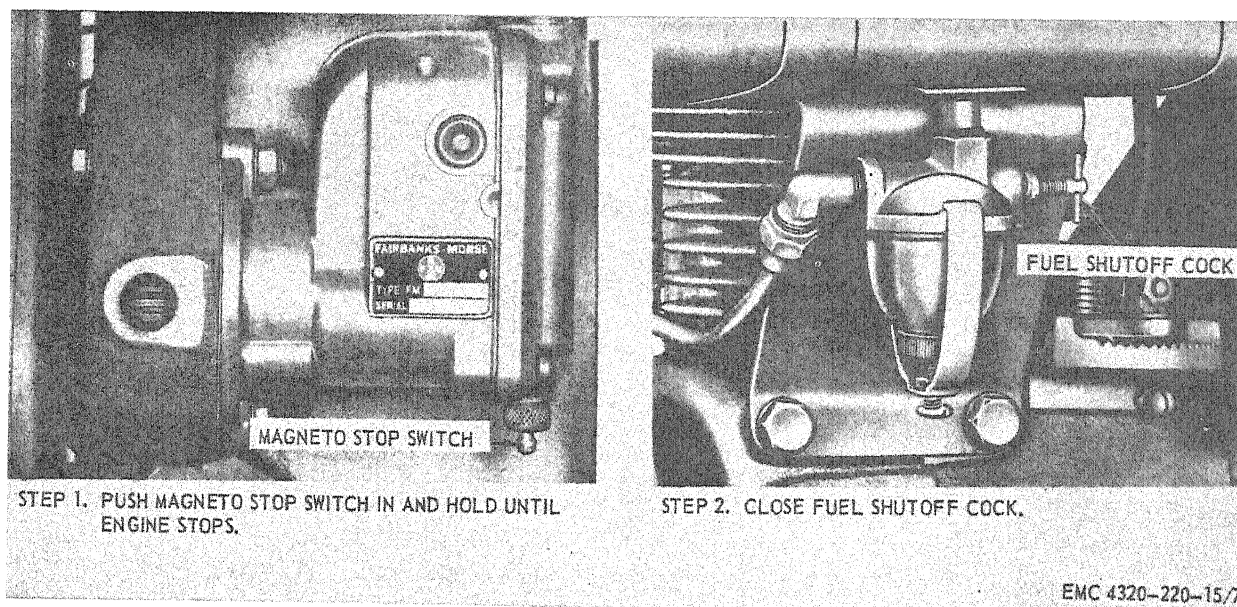


Figure 7. Engine stopping instructions.

- (2) Before operation, prime the pump with warm water (par. 16).

Caution: Do not use boiling water in the pump housing in cold weather.

20. Operation in Extreme Heat

a. *General.* Efficient cooling, adequate ventilation, and lubrication are of vital importance to the operation of the centrifugal pump in extreme heat.

b. *Cooling.* Protect the unit from direct rays of the sun, if possible. Maintain adequate space around the unit to provide proper ventilation. If operated inside an enclosure, install a fan to provide air circulation, if possible. Inspect the flywheel shroud and screen and cylinder crankcase fins for insufficient ventilation of the engine in extreme heat. Clean the fins and screen at regular intervals.

c. *Lubrication.* Lubricate the centrifugal pump in accordance with the current lubrication order for hot weather operation. Maintain the oil at proper level in the engine crankcase.

21. Operation in Dusty or Sandy Areas

a. *Protection.* Shield the unit from sand and dust. Take advantage of natural barriers

which offer protection from blowing sand or dust, or erect a suitable shield if possible.

b. *Cleaning.* Service the engine air cleaner frequently when operating the unit under dusty sandy conditions. Replace oil in the oil cup when it becomes dirty.

c. Fuel System.

- (1) Provide adequate protection to keep sand and dirt from entering the fuel tank when filling the tank.
- (2) Service the fuel strainer as often as necessary to keep it free of sand and dirt (par. 54).

d. *Cooling.* Keep the flywheel shroud and screen and cylinder crankcase fins free from all dust, dirt, and other material that might prevent proper engine cooling.

e. Lubrication.

- (1) Lubricate in accordance with the current lubrication order. Keep lubricants free of dust and sand. Keep lubrication points and lubrication equipment clean. Avoid excessive lubrication, as dust and sand will adhere to lubricants and work into lubrication areas.
- (2) Service the air cleaner more frequently than during normal operation (par. 28).

22. Operation Under Rainy or Humid Conditions

a. General. When the unit is not operating, place a canvas or other waterproof cover over the unit. During humid periods, dry the unit before operating. Keep the fuel tank full to avoid condensation.

b. Ignition System. The spark plug, magnet, and cable often become unserviceable because of high humidity. Affected parts should be removed and dried. If this does not remedy the condition, they must be replaced.

23. Operation in Salt Water Areas

a. General. Salt water creates a strong corrosive action on metal. Care must be taken to avoid direct contact with salt water. Wash down the entire unit with clean, fresh water at frequent intervals. Take care not to contaminate the fuel system or damage the ignition system with the water.

b. Protection Against Corrosion. Coat exposed metal surfaces with rustproofing material to keep moisture from causing rust. Remove any rust immediately and cover the exposed surfaces with a coat of paint. Refer to TM 9-2851 and TB ENG 60 for painting instructions.

c. Lubrication. See that the crankcase oil is not contaminated by salt water. Lubricate the unit in accordance with the current lubrication order.

24. Operation at High Altitudes

a. The pump will operate at high altitudes without special adjustment or servicing.

b. Make sure the air cleaner is clean and does not restrict the flow of air. Service the air cleaner frequently.

c. At high altitudes, it may be necessary to adjust the engine carburetor. Adjust the carburetor (par. 56).

Section V. OPERATION OF AUXILIARY MATERIAL USED IN CONJUNCTION WITH THE CENTRIFUGAL PUMP

25. Fire Extinguisher (Carbon Tetrachloride Type)

a. Description. A carbon tetrachloride fire extinguisher may be provided with the equipment. It is a vaporizing, liquid-type, pump-operated extinguisher, having a capacity of 1 quart.

b. Operation. Remove the fire extinguisher from its location; turn the handle and work the handle like that of a pump. Direct the stream at the base of the flame.

Warning: Be extremely careful when using a carbon tetrachloride fire extinguisher in an enclosed area. A poisonous gas is generated by the contact of carbon tetrachloride with a heated metallic surface. Provide adequate ventilation before entering an enclosed area where carbon tetrachloride has been used.

c. Refilling and Maintenance. For detailed information on refilling and maintenance, refer to TM 5-687 and TM 9-1799.

26. Fire Extinguisher (Monobromotrifluoromethane Type)

a. Description. The monobromotrifluoromethane type fire extinguisher replaces the

carbon dioxide and carbon tetrachloride type fire extinguishers used in the past. It is generally suitable for use on all types of fire, with the exception of fires involved with LOX (liquid oxygen) generating equipment. The fire extinguisher is furnished with a disposable type cylinder.

b. Operation. To operate the fire extinguisher, perform the following operations:

- (1) Remove the fire extinguisher from its location.
- (2) Break the seal by pulling the safety pin from the handle.
- (3) Point the horn at the base of the flame.
- (4) Depress the trigger for discharge and direct the stream of contents at the base of the fire.
- (5) Replace with a new cylinder immediately after using.

c. Replacement of Cylinder. To replace with a new cylinder, perform the following operations:

- (1) Press the lever to release the pressure from the old cylinder.

- (2) Loosen the swivel valve coupling nut and remove the valve assembly from the used cylinder.
- (3) Remove the instruction band from the used cylinder.
- (4) Place a new cylinder through the instruction band.
- (5) Replace the safety pin in the valve and the seal pin with sealing wire.
- (6) Attach the valve assembly and tighten the swivel coupling nut on the new

cylinder and replace the fire extinguisher in mounting bracket.

- (7) Adjust the instruction band on the cylinder to show maintenance and operating instructions.

d. Maintenance. Weigh fire extinguisher every 6 months and replace cylinder if gross weight has decreased 4 ounces or more. Lubricate cylinder neck threads with 1 drop of OE 30 oil before reassembly.

CHAPTER 3

OPERATOR AND ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Note. No special tools or equipment are required to perform maintenance on the operator or organizational maintenance personnel.

Section I. LUBRICATION

27. General Lubrication Information

a. This section contains a reproduction of the lubrication order (LO) and lubrication instructions, which are supplemental to and not specifically covered in, the lubrication order.

b. The lubrication order shown in figure 8 is an exact reproduction of the approved lubrication order for the centrifugal pump. For the current lubrication order, refer to DA Pam 310-4.

28. Detailed Lubrication Information

a. Care of Lubricants. Keep all lubricants (grease and oil) in closed containers and store in a clean, dry place away from heat. Allow no dirt, dust, water, or foreign material to mix with the lubricant at any time. Keep all lubrication equipment clean and ready for use.

b. Points of Application. Follow the detailed lubrication instructions given beneath each lubrication point illustration specified on the current lubrication order.

c. Cleaning. Keep all external parts not requiring lubrication clean from lubricants. After every lubrication operation, remove any excess lubricant from the point of application and wipe away any spilled lubricant. Old or hardened lubricants may be removed by using an approved cleaning solvent.

d. Operation After Lubrication. Operate the unit for 5 minutes after lubrication to work the clean oil into bearing surfaces. Stop the unit and check the oil level. Add oil to bring the oil level up to FULL mark, if necessary.

e. Engine Air Cleaner Servicing. Refer to figure 9 and remove the engine air cleaner.

LUBRICATION

ORDER

LO 5-4320-220-15

**PUMP, CENTRIFUGAL: GASOLINE DRIVEN; BASE MTD;
2 IN; 166 GPM, 25 FT HEAD, (BARNES MODEL
10-MG) W/WISCONSIN ENGINE
MODEL MAENLD**

Reference: Skt 10-1-C4-1

Intervals are based on normal operation. Reduce to compensate for abnormal operations and severe conditions. During inactive periods sufficient lubrication must be performed for adequate preservation.

Clean fittings before lubricating.

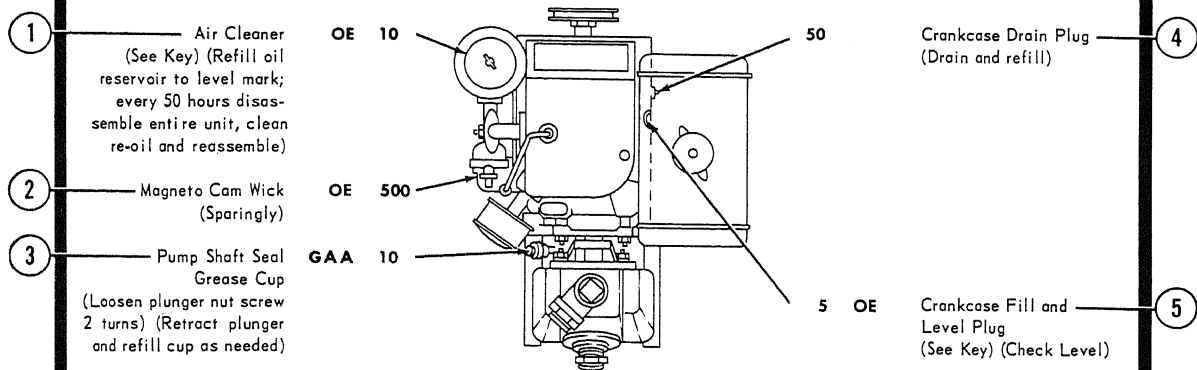
Relubricate after washing.

Clean parts with SOLVENT, dry-cleaning; or with OIL, fuel, Diesel. Dry before lubricating.

Drain crankcase only when hot after operation; replenish and check level when cool.

LUBRICANT • INTERVAL

INTERVAL • LUBRICANT



CONTINUED ON
FOLLOWING PAGE

EMC 4320-220-15/8 ①

1 Front

Figure 8. Lubrication order—LO 5-4320-220-15.

CONTINUED FROM
PRECEDING PAGE
— KEY —

LUBRICANTS	CAPACITY	EXPECTED TEMPERATURES			INTERVALS
		Above +32°F	+40°F to -10°F	0°F to -65°F	
OE-OIL, Engine, Heavy Duty		OE 30 or 9250	OE 10 or 9110	OES	Intervals given are in hours of normal operation.
Crankcase	1-1/2 qt				
Air Cleaner	3/16 qt				
Oil Can Points					
OES-OIL, Engine Subzero		All Temperatures			
GAA-GREASE, Automotive and Artillery					

NOTES:

1. FOR OPERATION OF EQUIPMENT IN PROTRACTED COLD TEMPERATURES BELOW -10°F. Remove lubricants prescribed in the key for temperatures above -10°F. Clean parts with SOLVENT, dry-cleaning. Relubricate with lubricants specified in the key for temperatures below -10°F.

Copy of this Lubrication Order will remain with the equipment at all times; instructions contained herein are mandatory.

BY ORDER OF THE
SECRETARY OF THE ARMY:

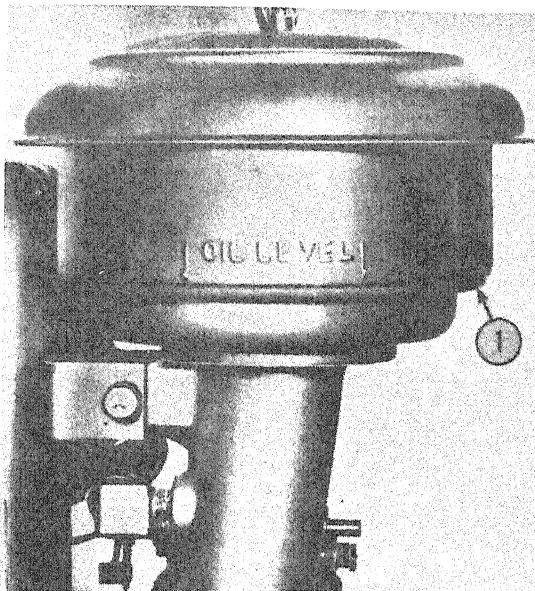
G. H. DECKER,
General, United States Army,
Chief of Staff.

OFFICIAL:

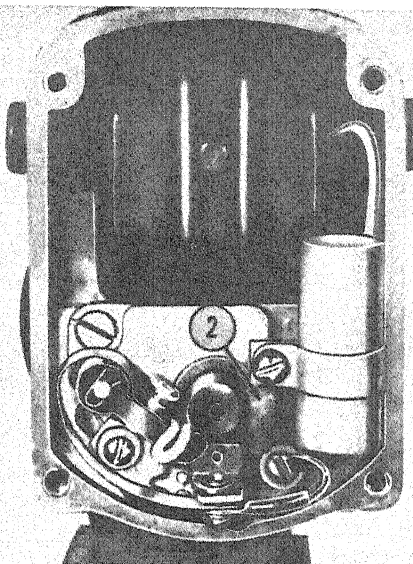
R. V. LEE,
Major General, United States Army,
The Adjutant General.

2. OIL CAN POINTS. Every 50 hours clean and lightly coat the governor and carburetor linkage with OE.

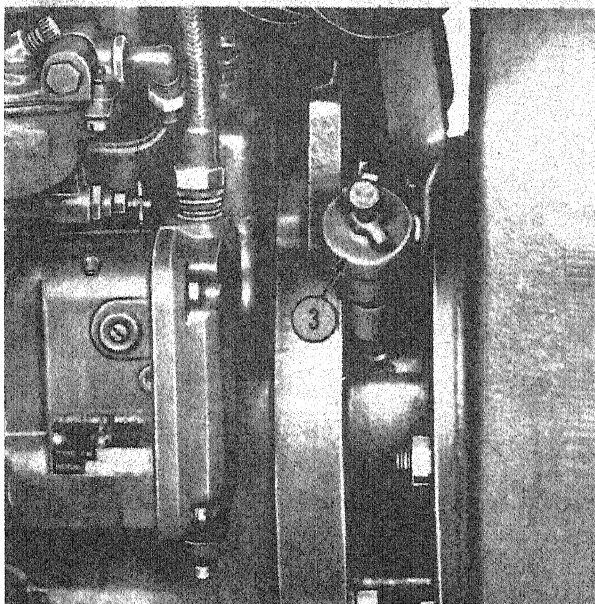
EMC 4320-220-15/8 ②



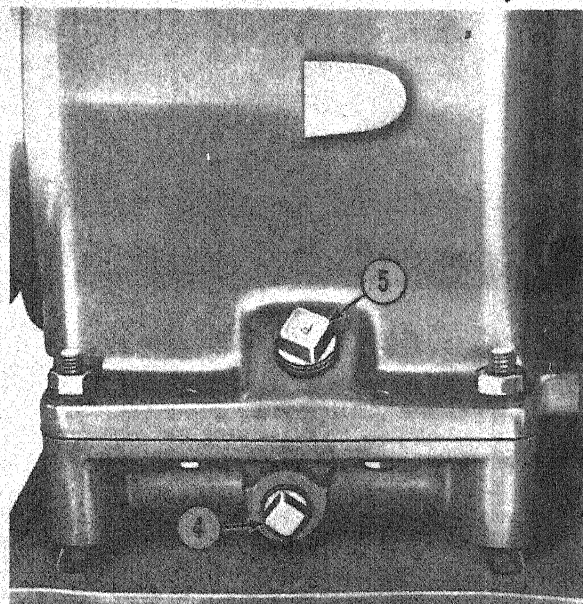
REF. 1. AIR CLEANER



REF. 2. MAGNETO CAM WICK



REF. 3. PUMP SHAFT SEAL GREASE CUP



REF. 4. CRANKCASE DRAIN PLUG
REF. 5. CRANKCASE FILL AND LEVEL PLUG

EMC 4320-220-15/8 ③

3 References 1 through 5

Figure 8—Continued.



Figure 9. Engine air cleaner, servicing.

Section II. PREVENTIVE MAINTENANCE SERVICES

29. Operator's Maintenance

To insure that the equipment is ready for operation at all times, it must be inspected systematically before operation, during operation, and after operation, so that defects may be discovered and corrected before they result in serious damage or failure. The necessary preventive maintenance services will be **performed before operation. Defects discovered during operation of the unit will be noted for future correction, to be made as soon as operation has ceased. Stop operation immediately if a deficiency is noticed during operation which would damage the equipment if operation were continued. After-operation services will be performed at intervals based**

on the normal operations of the equipment. Reduce interval to compensate for abnormal conditions. Defects or unsatisfactory operating characteristics beyond the scope of the operator to correct must be reported to organizational maintenance at the earliest opportunity. Responsibility for performance of preventive maintenance services rests not only with the operator but also with the entire chain of command from section chief to commanding officer (AR 750-5).

30. Operator's Daily Services

a. *General.* The intervals at which the operator's daily services are to be performed are indicated by an x, in the appropriate column,

on the small tab located at the bottom of each illustration in figure 10. The tab columns are B (before), D (during), and A (after) operation of the equipment. The intervals and services not illustrated are prescribed in *b* through *d* below.

b. Before-operation Services.

- (1) *Visual inspection.* Make a visual inspection of the centrifugal pump for cracks, breaks, and loose or missing bolts and nuts. Inspect to see whether the centrifugal pump has been tampered with or damaged. Look for evidence of fuel or oil leaks underneath the engine. Inspect to see whether the centrifugal pump is as level as possible. Correct all deficiencies noticed or report the condition immediately to organizational maintenance.
- (2) *Publications.* See that a copy of this manual, the current lubrication order, and DA Form 285 are on or with the centrifugal pump and in serviceable condition.
- (3) *Lubrication.* Determine whether lubrication services have been performed since the last operation of the centrifugal pump. Lubricate as required in accordance with the current lubrication order and as instructed in paragraph 28.

c. During-operation Services.

- (1) *Visual inspection.* Observe the centrifugal pump while in operation for leaks. Make sure the unit remains stationary and as level as possible. Shut down the operation and correct or report deficient conditions to organizational maintenance. Do not resume operation until the deficient conditions have been corrected.
- (2) *Unusual operation and noises.* Observe the centrifugal pump while in operation for loose mountings, excessive vibrations, unusual noises, overheating, smoking, and erratic pump intake or discharge. If any of these noises or irregularities are noticed, shut down the operation at once and

correct or report the condition to organizational maintenance. Do not resume operation until the condition has been corrected.

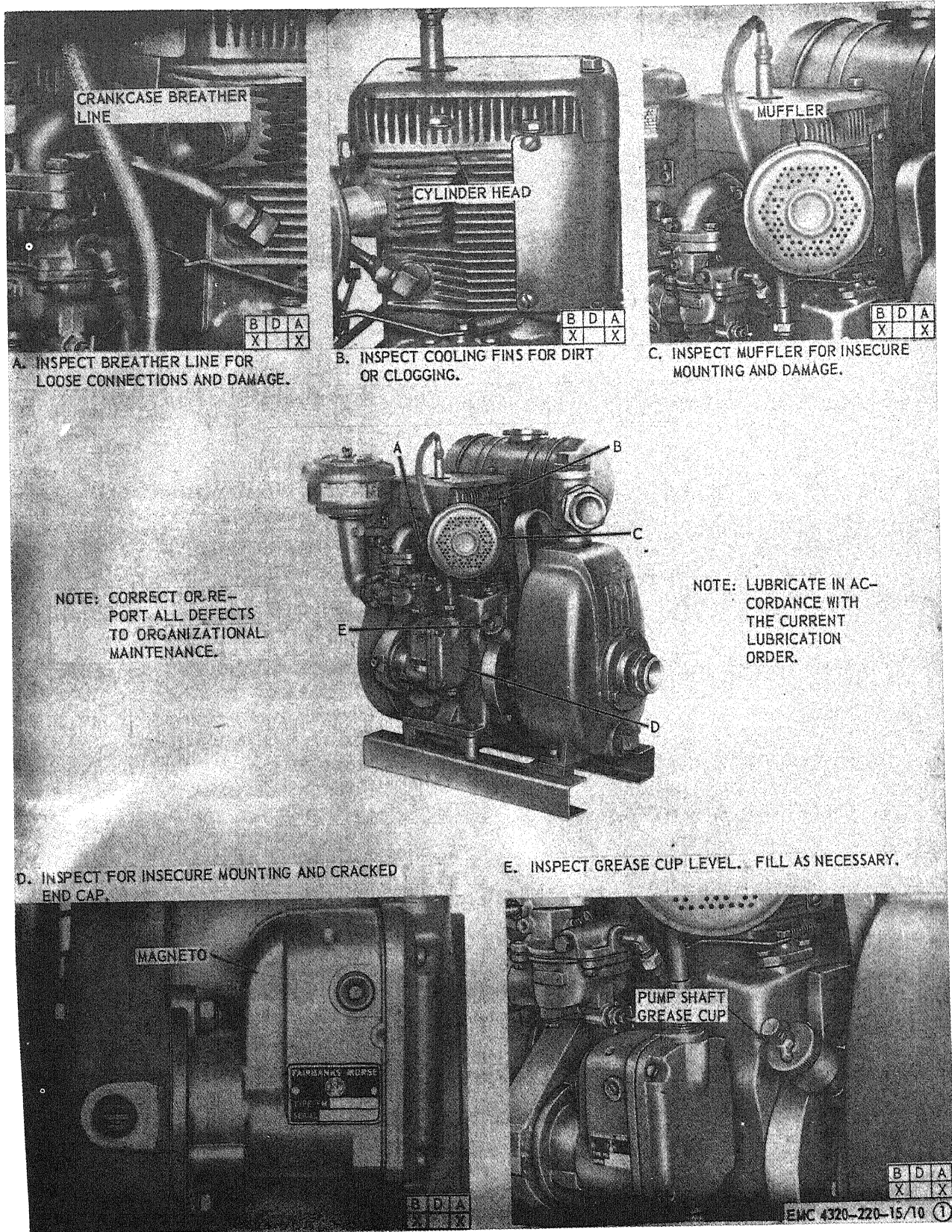
d. After-operation Services.

- (1) *Engine.* Inspect the fuel tank and replenish the fuel supply. Check the oil level in the crankcase and add oil if necessary, in accordance with the current lubrication order.
- (2) *Lubrication.* Lubricate as required in accordance with the current lubrication order and as instructed in paragraph 28.
- (3) *Visual inspection.* Make a complete visual inspection of the centrifugal pump for cracks, breaks, and loose or missing bolts and nuts. Inspect the fuel line for leaks. Correct or report these conditions to organizational maintenance.
- (4) *Cleaning.* Clean all dirt, grease, sludge, and oil from the centrifugal pump with an approved cleaning solvent and wipe dry.
- (5) *Protection.* Protect the centrifugal pump from damage, tampering, and the elements by covering it with a canvas cover or placing it in a sheltered place. When the centrifugal pump is inactive for any length of time, unpainted parts should be covered with an approved rust preventive compound.

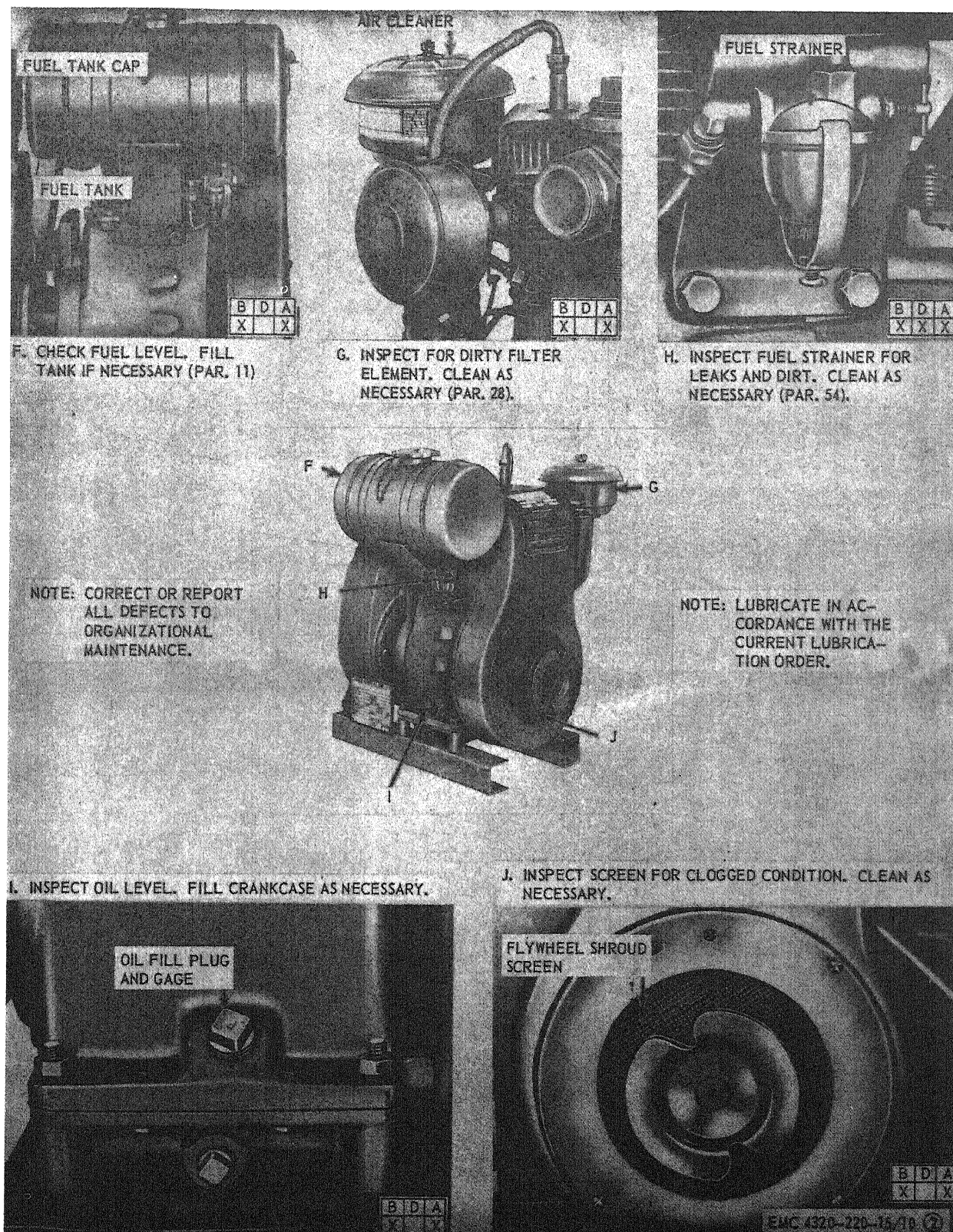
31. Organizational Maintenance

a. Preventive maintenance is performed by organizational maintenance personnel at quarterly intervals. A quarterly interval is equivalent to 3 calendar months or 250 hours of operation, whichever occurs first.

b. The Preventive Maintenance Services to be performed at quarterly intervals are listed consecutively (starting with number 1) and are described in paragraph 26. The number opposite each service refers to a Preventive Maintenance Service "Title" on DA Form 464 and indicates the services to be performed. The number listed under "Inspection"



(1) References A through E.
Figure 10. Operator's daily services.



(2) References F through J.
Figure 10—Continued.

indicates the minimum inspection requirements for the equipment.

32. Quarterly Preventive Maintenance Services

Inspection	Service quarterly	GENERAL
1	1	<i>Before-Operation Services.</i> Perform the daily services listed in paragraph 30.
2	2	<i>Lubrication.</i> Inspect the centrifugal pump for indications of insufficient lubrication. Inspect for a damaged drain plug or grease cup.
	2	Lubricate the equipment in accordance with paragraphs 27 and 28. Replace a damage drain plug (par. 55). Replace a damaged grease cup (par. 70).
3	3	<i>Tools and Equipment.</i> Inspect the condition of all tools and equipment assigned to the centrifugal pump.
	3	See that all tools and equipment assigned to the centrifugal pump are clean and serviceable.
4	4	<i>Fire Extinguishers.</i> Inspect the carbon tetrachloride type fire extinguisher every 4 months for improper charge and damage. Refer to TM 5-687 and TM 9-1799. Weigh a monobromotrifluoromethane type fire extinguisher every 6 months and replace the cylinder if the gross weight has decreased 4 ounces or more. Lubricate neck with 1 drop of OE 30 oil before reassembly.
	4	Replace a defective fire extinguisher.
5	5	<i>Publications.</i> See that a copy of this manual, the current lubrication order, and DA Form 285 are on or with the equipment and in serviceable condition.
6	6	<i>Appearance.</i> Inspect the general appearance of the centrifugal pump for dirt, illegibility of identification markings, and chipped or cracked paint.
	6	Correct all deficient conditions in appearance of the centrifugal pump.
7	7	<i>Modifications.</i> See that all available modification work orders apply to the centrifugal pump have been completed and recorded on DA Form 478, DA Form 5-73, or DA Form 5-73a, as applicable.
ENGINE		
8	8	<i>Cylinder, Head, Manifold, Muffler, And Pipe.</i> Inspect the cylinder head, intake manifold, exhaust muffler, and pipe for leaks, loose bolts, and defective gaskets.

Inspection	Service quarterly	GENERAL
	8	Tighten loose cylinder head bolts or replace the gasket (par. 66). Replace a defective exhaust muffler and pipe (par. 49). Replace a defective intake manifold and gasket (par. 57).
9	9	<i>Valve Mechanism.</i> Inspect the valve inspection cover plate and gasket for oil leaks. If excessive valve lifter noise or loss of power is noticed, measure the valve lifters for proper clearance.
	9	Replace a leaking valve inspection cover plate or gasket (par. 67). Adjust the valve lifter clearance if necessary (par. 67.)
10	10	<i>Compression Test.</i> Remove the spark plug and insert a compression gage in the cylinder head. Crank the engine with the starting rope and note gage reading. The gage reading should be 85 to 95 psi (pounds per square inch). A compression test reading of less than 85 psi indicates faulty valves, pistons, piston rings, or cylinder head gasket.
	10	Determine whether the cylinder head gasket, piston, or piston rings are faulty by pouring 1 fluid ounce of an approved crankcase lubricant into the cylinder chamber and repeat the test. This compression test reading should be higher than before adding the lubricant to the cylinder chamber. If low compression is still evident, the valves are defective. Report the condition to field maintenance.
	11	<i>Crankcase Breather Line.</i> Inspect the crankcase breather line of leaks and loose fittings or any other damage.
	11	Tighten loose fittings or replace a damaged breather line (par. 51).
	12	<i>Flywheel and Shroud.</i> Inspect the flywheel for cracks and broken vanes. Inspect the flywheel shroud for bends, cracks, loose mounting bolts, and improper alignment with the flywheel.
	12	Replace a defective flywheel (par. 65). Tighten loose bolts in the flywheel shroud. Repair or replace a damaged flywheel shroud (par. 50).
13	13	<i>Starting Sheave.</i> Inspect the starting sheave for nicks, burs, cracks, breaks, and looseness.
	13	Smooth out nicks, remove burs, tighten a loose starting sheave or replace a defective starting sheave (par. 64).

Inspection	Service quarterly	GENERAL
14	14	<i>Governor and Linkage.</i> Inspect the governor linkage for worn, damaged, or defective parts.
	14	Replace any defective governor linkage and adjust the linkage (par. 58). Report any governor condition that cannot be corrected to field maintenance.
15	15	<i>Carburetor and Linkage.</i> Inspect the carburetor for leakage, damage, and loose mounting. Inspect the choke and governor carburetor linkage for binding and worn condition.
	15	Tighten a loose fuel line fitting and mounting hardware. Replace a defective carburetor if necessary (par. 56). Repair or replace worn or damaged linkage.
16	16	<i>Fuel Strainer.</i> Inspect the fuel strainer for leakage, damage, and loose mounting. Inspect the glass bowl for evidence of sediment and water.
	16	Remove the glass bowl and dispose of any sediment and water. Tighten a loose fuel line fitting mounting hardware. Replace the gasket if necessary and repair or replace a defective fuel strainer (par. 54).
17	17	<i>Air Cleaner.</i> Inspect the air cleaner for loose connections and mounting. Inspect the oil cup for presence of dirt and improper oil level. Inspect the air cleaner for dents, cracks, and other damage.
	17	Service the air cleaner as instructed in paragraph 28. Tighten all loose mounting hardware. Replace a defective air cleaner (par. 59).
18	18	<i>Fuel Tank, Cap, and Gaskets.</i> Inspect the fuel tank for leaks, other damage, and insecure mounting straps and bracket. Remove and inspect the fuel cap and gasket for evidence of damage. Make sure the gasket is in a serviceable condition.
	18	Replace a defective fuel tank cap, or gasket. Tighten fuel tank mounting straps and bracket if necessary. Replace a defective fuel tank (par. 53).
19	19	<i>Fuel Lines.</i> Inspect the fuel strainer-to-carburetor fuel line for cracks, breaks, kinks, and leakage.
	19	Tighten loose connections. Replace a defective fuel line (par. 54).
20	20	<i>Spark Plug and Cable.</i> Inspect the spark plug for cracked porcelain, burned electrodes, carbon deposits, and incorrect gap. The correct gap is 0.030 inch.

Inspection	Service quarterly	GENERAL
		Use a suitable spark plug tester and test the spark plug for proper operation. Inspect the cable for damage and loose or corroded connections.
	20	Clean and adjust the spark plug (par. 62). Replace a defective spark plug and cable (par. 62). Tighten all loose connections.
21	21	<i>Magneto.</i> Inspect the magneto for cracks, breaks, and loose mounting. Inspect the spark plug cable connections for looseness and corrosion. Remove the end cap cover inspect the breaker points for wear, pitting, and improper separation (par. 61). The correct separation adjustment is 0.015 inch. Inspect the vent screen for cleanliness.
	21	Tighten all loose mounting hardware and cable connections. Remove all dirt, grease, and corrosion. Clean and adjust the breaker points (par. 61). Report a defective contact set to field maintenance. Remove and service the magneto vent screen (par. 61). Replace a defective magneto (par. 61).
		CENTRIFUGAL PUMP
22	22	<i>Valves.</i> Inspect the suction valve for leaks and improper operation. Repair a defective suction valve (par. 70).
23	23	<i>Frame.</i> Inspect the base rails for cracks, breaks, and other damage.
	23	Replace defective base rails (par. 68).
24	24	<i>Couplings.</i> Inspect the coupling for cracks, breaks, loose mounting hardware, and misalignment.
	24	Tighten all loose mounting hardware. Replace a defective coupling (par. 70).
25	25	<i>Impeller.</i> If the pump is noisy, inspect the impeller for looseness or damage.
	25	Tighten if loose or replace a damaged impeller (par. 70).
26	26	<i>Grease Seal.</i> Inspect the grease seal for evidence of dryness or leakage.
	26	Lubricate the grease seal in accordance with the current lubrication order. Replace a defective grease seal (par. 70).
27	27	<i>Pump Housing.</i> Inspect the pump body for cracks, breaks, misalignment, and loose or missing mounting hardware.
	27	Tighten or replace all loose or missing mounting hardware. Replace a damaged pump body (par. 70).

Section III. OPERATOR AND ORGANIZATIONAL MAINTENANCE TROUBLESHOOTING

33. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the centrifugal pump and its components. Each trouble symptom stated is followed by a list of probable causes of the trouble. The possible remedy recommended is described opposite the probable cause. Any operational trouble that is beyond the scope of organizational maintenance must be reported to field maintenance, third echelon.

34. Engine Is Hard to Start or Fails to Start

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel tank empty	Fill the fuel tank (par 11).
Fuel shutoff valve closed	Open the fuel shutoff valve.
Fuel mixture improper	Adjust the carburetor (par. 56). Replenish the fuel supply with correct grade of fuel (Refer to Table I).
Fuel strainer clogged	Service the fuel strainer (par. 54).
Carburetor clogged	Clean or replace the carburetor (par. 56).
Cylinder flooded	Close the high-speed adjustment valve, open the governor control, and crank the engine until the excess fuel is removed.
Spark plug dirty or damaged	Clean, adjust, or replace the spark plug (par. 62).
Magneto breaker points out of adjustment or the contact set defective	Adjust the breaker points (par. 61). Report the defective contact set to field maintenance.
Magneto defective	Replace the magneto (par. 61).
Ignition cable defective	Replace the ignition cable (par. 62).
Magneto out of timing	Retime the magneto (par. 61).

35. Engine Misses or Runs Erratically

<i>Probable cause</i>	<i>Possible remedy</i>
Spark plug dirty or damaged	Clean, adjust, or replace the spark plug (par. 62).
Ignition cable loose or defective	Tighten or replace the ignition cable (par. 62).

Magneto breaker points out of adjustment or the contact set defective ----- Adjust breaker points (par. 61).
Report the defective contact set to field maintenance.

Valve lifter clearance incorrect ----- Adjust the valve lifter clearance (par. 67).

Carburetor out of adjustment or defective ----- Adjust or replace the carburetor (par. 56).

Fuel strainer clogged ----- Service the fuel strainer (par. 54).

Carburetor choke partially closed ----- Open the choke fully.

Air cleaner clogged or air flow restricted ----- Service the air cleaner (par. 28). Provide proper ventilation.

Governor linkage out of adjustment ----- Adjust the governor linkage (par. 58).

Fuel tank contains water ----- Drain the fuel tank and replenish with the proper grade of fuel (par. 11). Service the fuel strainer (par 54).

36. Engine Knocks

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel of poor grade	Drain the fuel tank and replenish with the proper grade of fuel (par. 11).
Crankcase oil level low	Fill the crankcase to proper level.
Engine under heavy load at low speed	Open the governor control.
Ignition timing advanced too far	Retime the ignition (par. 61).

37. Engine Exhaust Smoke Excessive

<i>Probable cause</i>	<i>Possible remedy</i>
Carburetor out of adjustment	Adjust, clean, or replace the carburetor (par. 56).
Fuel poor grade	Drain the fuel tank and replenish with the proper grade fuel (par. 11).
Air cleaner dirty	Service air cleaner (par. 28).

38. Engine Overheats

<i>Probable cause</i>	<i>Possible remedy</i>
Crankcase oil level low	Fill to proper level.
Fuel of poor grade	Drain the fuel tank and replenish with proper grade of fuel (par. 11).
Air flow restricted	Provide adequate ventilation. Clean the cooling fins.
Fuel mixture too lean	Adjust the carburetor (par. 56).
Exhaust restricted	Remove and clean the muffler and pipe nipple (par. 49).

39. Engine Backfires

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel contains dirt or water	Drain the fuel tank and replenish with the proper grade of fuel (par. 11).
Fuel strainer clogged	Service the fuel strainer (par. 54).
Fuel mixture too lean	Adjust the carburetor (par. 56).
Timing incorrect	Reset the timing (par 61).
Intake valve sticking	Remove the spark plug and pour a small amount of preservative oil into the engine block to loosen the valve
Spark plug too hot	Install the spark plug with correct heat range (par. 62).

40. Engine Lacks Power

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel strainer-to-carburetor line restricted	Remove restriction or replace the fuel line (par. 54).
Engine filled with carbon	Remove the cylinder head (par. 66) and clean carbon from engine.
Fuel strainer clogged	Service the fuel strainer (par. 54).
Fuel mixture too lean	Adjust the carburetor (par. 56).
Ignition poor	Service or replace the spark plug (par. 62). Adjust the magneto breaker points (par. 61).
Air cleaner restricted	Service the air cleaner (par. 28).

Exhaust restricted	Remove and clean the muffler and pipe nipple (par. 49).
Timing improper	Reset the timing (par 61).
Governor control out of adjustment	Adjust the governor spring (par. 58).

41. Engine Stops Suddenly

<i>Probable cause</i>	<i>Possible remedy</i>
Fuel tank empty	Fill the fuel tank with the proper grade of fuel (par. 11).
Fuel strainer clogged	Service the fuel strainer (par. 54).
Carburetor defective	Clean or replace the carburetor (par. 56).
Fuel tank cap air vent hole plugged	Remove the restriction
Air cleaner clogged	Service the air cleaner (par. 28).

42. Pump Fails to Function Properly

<i>Probable cause</i>	<i>Possible remedy</i>
Impeller broken, damaged, or worn	Replace the impeller (par. 70).
Air entering the pump body	Tighten loose hose connections. Inspect the hoses for air leaks.
Suction valve defective	Repair or replace the suction valve (par. 70).
Seal defective	Replace the seal (par. 70).
Suction or discharge flange adapters loose	Tighten the suction and discharge flange adapters (par. 70).
Pump body defective	Repair or replace the pump body (par. 70).

43. Pump Noisy

<i>Probable cause</i>	<i>Possible remedy</i>
Impeller loose, broken, or damaged	Tighten loose impeller mounting or replace a defective impeller (par. 70).
Seal defective	Replace the seal (par. 70).

44. Pump Fails to Prime

<i>Probable cause</i>	<i>Possible remedy</i>
Engine speed too slow	Increase the engine speed.
Liquid loss in pump volute	Reprime the pump (par. 16).

45. Pump Fails to Deliver Rated Capacity*Probable cause**Possible remedy*

Pump not primed ----- Prime the pump (par. 16).
 Engine speed too slow ----- Increase the engine speed.

46. Pump Leaks*Probable cause**Possible remedy*

Shaft seal assembly dry or worn ----- Fill the shaft assembly (par. 70) with grease in accordance with the current lubrication order.

47. Field Expedient Repairs

Operational troubles may occur while the pumping unit is operating in the field where supplies and repair parts are not available and normal remedial action cannot be performed. When this condition exists, the expedient remedies listed below may be used only upon the decision of the unit commander. Equipment so re-

paired must be removed from operation at the earliest possible moment and properly repaired before being placed in operation again.

*Trouble**Expedient remedy*

a. Air cleaner clogged ----- Remove the air cleaner (par. 59c).

Caution: Operating the unit in sandy or dusty areas without the air cleaner can cause serious damage to the engine.

Caution: Operating the unit with dirty fuel and no fuel strainer in the system can result in engine stoppage and damage to the carburetor.

b. Fuel line cracked or leaking ----- Wrap the line with plastic tape (par. 54d).
 c. Magneto stop switch defective ----- Remove the stop switch and tape the end of the switch lead (par. 61k).
 d. Spark plug defective -- Bend the electrodes closer together (par. 62c).
 e. Engine cylinder head gasket defective ----- Tighten down the cylinder head or mend the broken place (par. 66f).

Section IV. EXHAUST MUFFLER AND ENGINE COOLING SYSTEM**48. General**

A combination fan and flywheel forces a flow of air through the flywheel shroud to circulate around the cylinder and cylinder head. The exhaust muffler and breather line are mounted on the cylinder crankcase.

49. Exhaust Muffler

- a. Remove and install the exhaust muffler as shown by figure 11.
- b. Clean and inspect.

50. Cylinder Head Cover and Flywheel Shroud

- a. Remove and install the rope starting sleeve (par. 64).
- b. Disconnect the ignition cable (par. 62).
- c. Remove and install the flywheel (par. 65).
- d. Remove and install the cylinder head cover and flywheel shroud as shown by figure 12.
- e. Clean and inspect.

51. Engine Crankcase Breather Line

- a. Remove and install the engine crankcase breather line as shown by figure 11.
- b. Clean and inspect.

Section V. FUEL SYSTEM**52. General**

The engine fuel system consists of a fuel tank, a combination shutoff cock and fuel strainer, a fuel line from the strainer to the float-type carburetor, governor control assembly and linkage, and an air cleaner. The fuel system is a gravity-feed type requiring no fuel pump. Fuel flows from the tank to the fuel line strainer which re-

moves solids and water from the fuel, collecting this foreign matter in a removable sediment bowl. From the strainer the fuel passes into the carburetor. The oil-bath-type air cleaner removes dust and grit from the air and passes clean air to the carburetor, where it is mixed with the fuel for proper combustion.

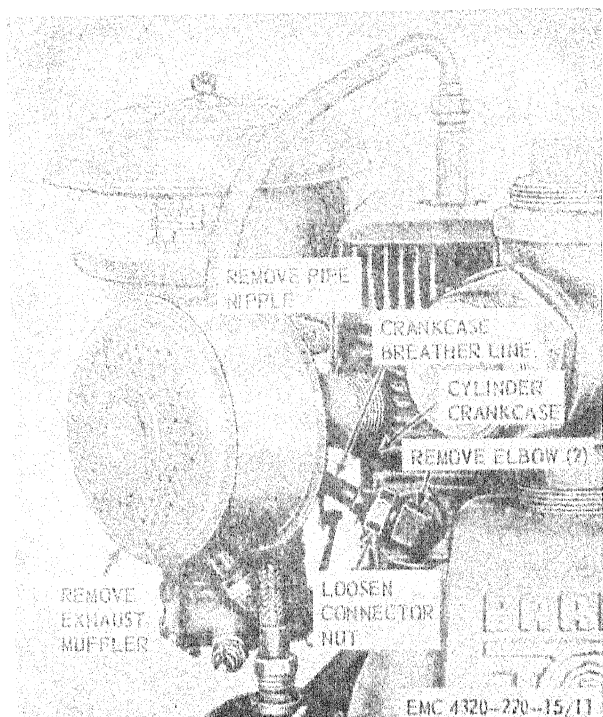


Figure 11. Exhaust muffler and crankcase breather line, removal and installation.

53. Fuel Tank, Cap, Screen, and Bracket

- Close the fuel shutoff cock (par. 54).
- Remove and install the cylinder head cover and spacer (par. 50).
- Remove and install the assembled fuel tank, cap, screen, and bracket from the cylinder crankcase as shown by figure 13.
- Clean and inspect.

54. Fuel Strainer and Line

- Service, remove, and install the fuel strainer and line as shown by figure 14.
- Clean and inspect.
- Perform field expedient repairs on the fuel line by wrapping with plastic tape.

55. Oil Fill Plug and Gauge and Oil Drain Plug

- Remove and install the oil fill plug and gage and oil drain plug as shown by figure 13.
- Clean and inspect.

56. Carburetor

- Remove and install the air cleaner (par. 59).
- Close the fuel shutoff cock and remove and install the fuel line (par. 54).
- Remove and install the carburetor and the intake manifold as shown by figure 15. Discard gasket.
- Disassemble and reassemble the carburetor as shown by figure 16.
- Clean and inspect.
- Adjust the carburetor as shown by figure 17.

57. Intake Manifold

- Remove and install the carburetor (par. 56).
- Remove and install the intake manifold as shown by figure 15.
- Clean and inspect.

58. Governor Control Assembly and Linkage

- Remove and install the exhaust muffler (par. 49).
- Remove and install the governor control assembly as shown by figure 18.
- Disassemble and reassemble the governor control assembly and linkage as shown by figure 19.
- Clean, inspect, and repair.
- Adjust the governor linkage as shown by figure 18.

59. Engine Air Cleaner and Bracket

- Remove and install the air cleaner bracket clip as shown by figure 12.
- Remove and install the engine air cleaner and bracket as shown by figure 20.
- Clean and inspect.
- Service the air cleaner (par. 28).
- Perform field expedient repairs on the air cleaner by operating the engine without the air cleaner and attaching a fine-meshed screen or cloth over the open carburetor to filter foreign particles.

Caution: Operation of the engine in sandy or dusty areas without the air cleaner can result in damage to the engine.

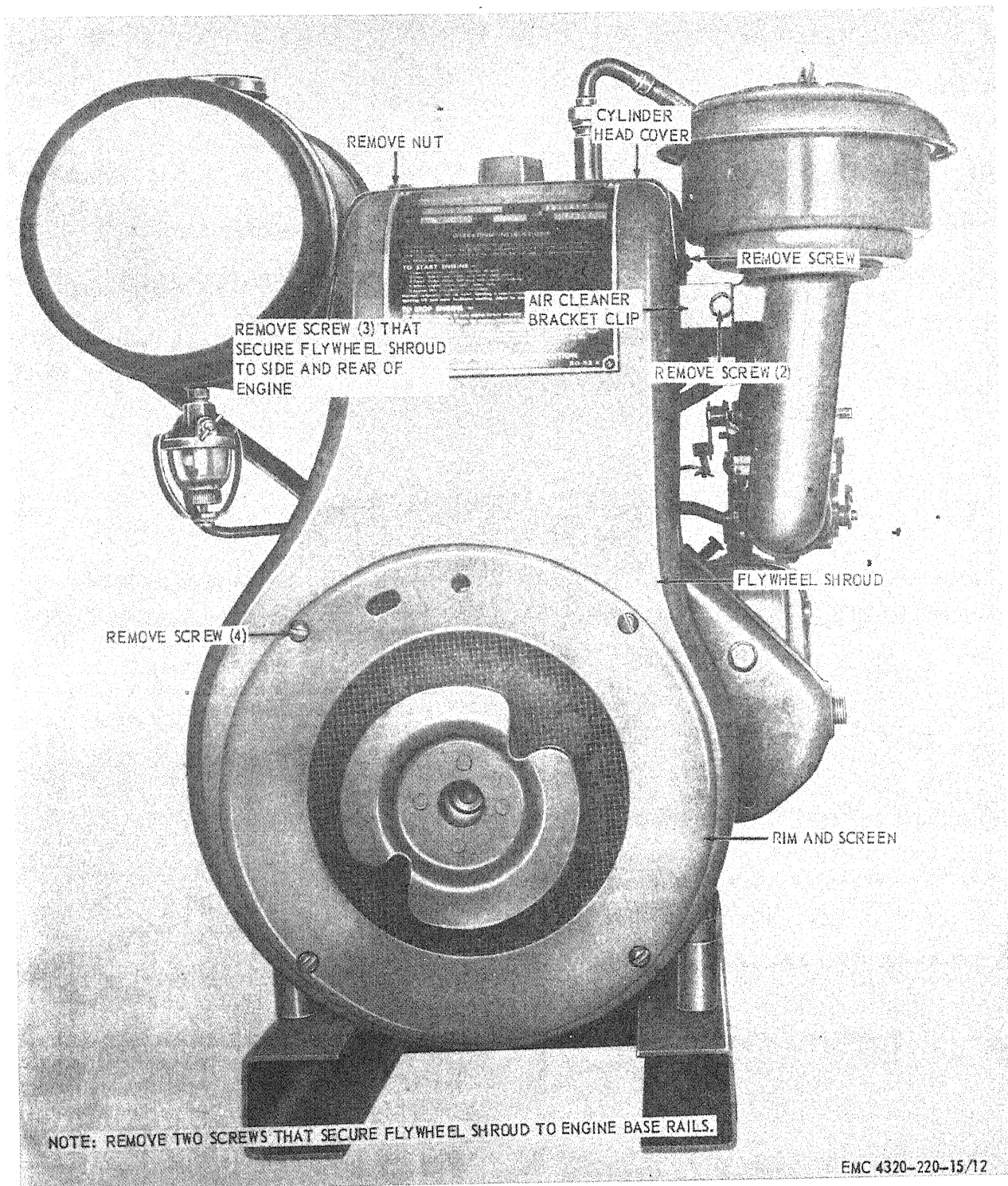


Figure 12. Cylinder head cover and flywheel shroud, removal and installation.

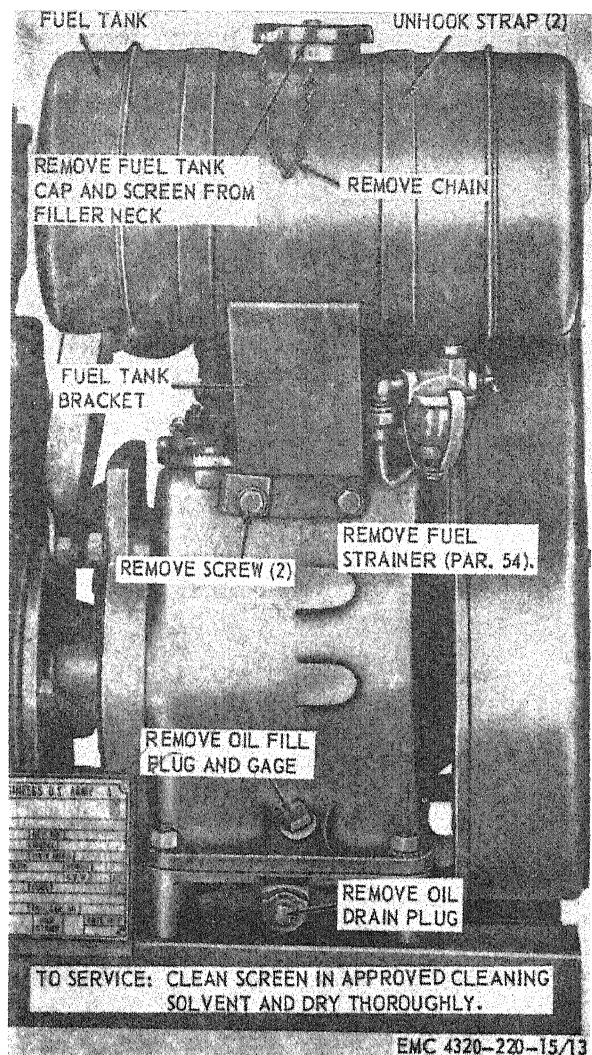


Figure 13. Fuel tank, cab, strainer, screen, oil fill plug and gage, and oil drain plug, removal and installation.

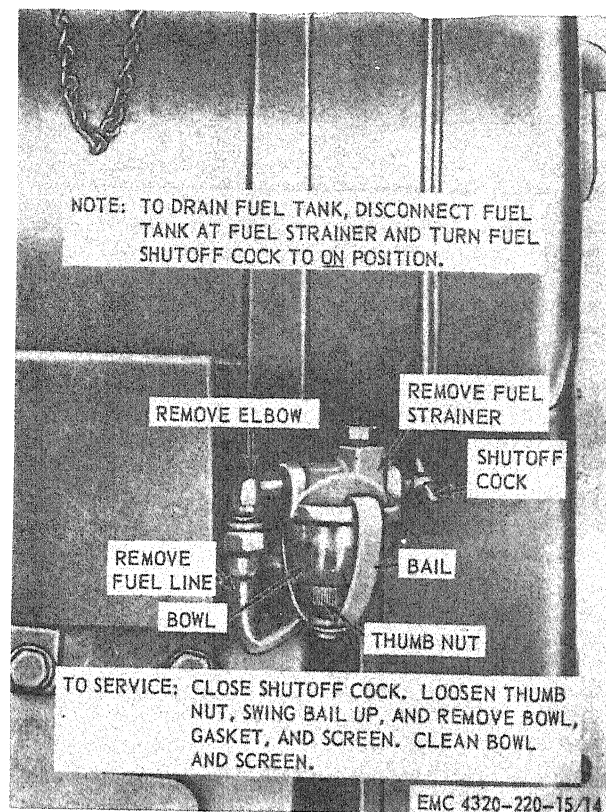


Figure 14. Fuel strainer and line, removal and installation, and fuel strainer servicing.

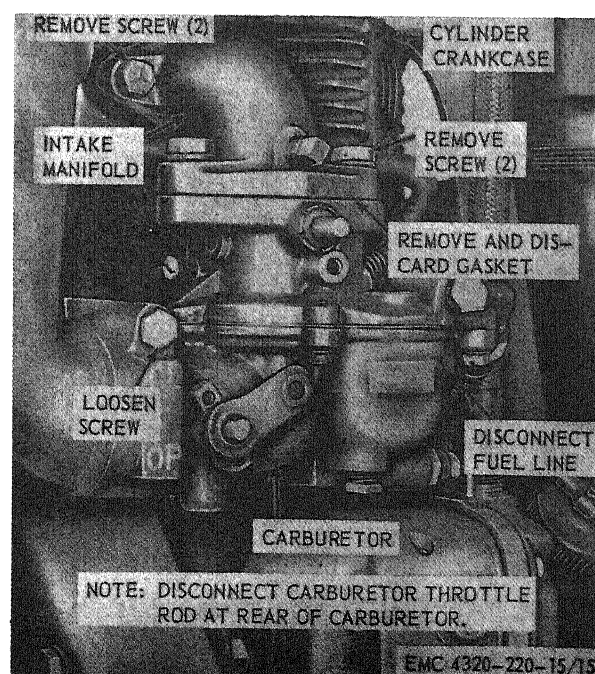
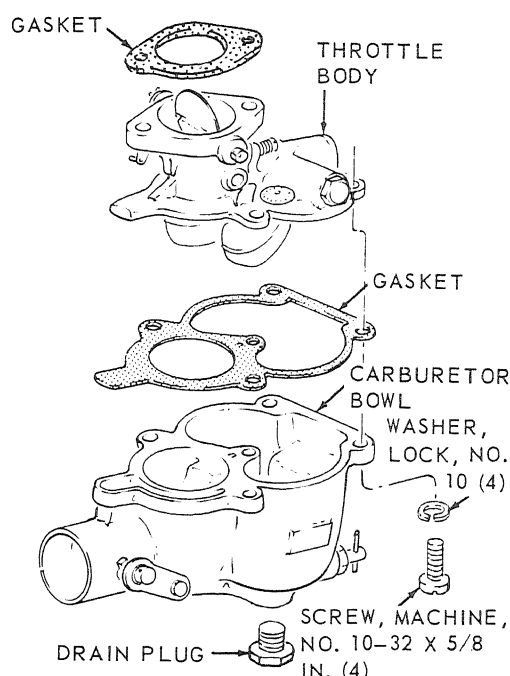


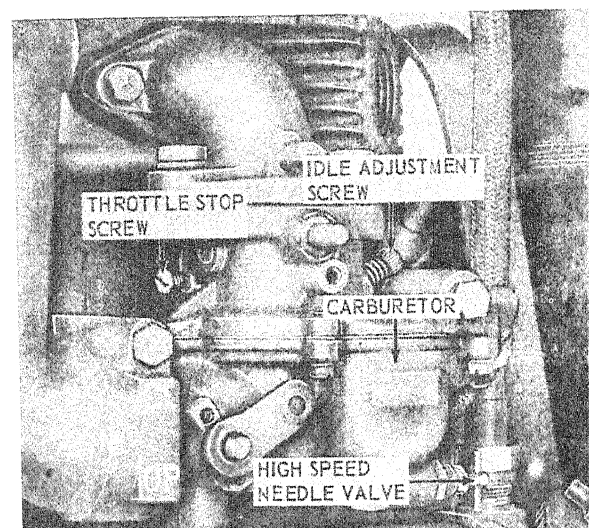
Figure 15. Carburetor and intake manifold, removal and installation.



TO SERVICE: REMOVE CARBURETOR FROM ENGINE AND DRAIN FUEL FROM CARBURETOR BOWL. SEPARATE CARBURETOR BOWL FROM THROTTLE BODY. REMOVE FLOAT AXIAL PIN AND REMOVE FLOATS. REMOVE AND DISCARD GASKET. CLEAN CARBURETOR BOWL IN AN APPROVED CLEANING SOLVENT AND DRY THOROUGHLY. REASSEMBLE CARBURETOR AND REPLACE GASKET.

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Figure 16. Carburetor, disassembly and reassembly, and carburetor servicing



- STEP 1. SET IDLE ADJUSTMENT SCREW 3/4 TO 1-1/4 TURNS OPEN.
- STEP 2. SET HIGH SPEED NEEDLE VALVE 1-1/2 TO 2 TURNS OPEN.
- STEP 3. START ENGINE AND ALLOW IT TO REACH OPERATING TEMPERATURE (PAR. 16).
- STEP 4. WITH ENGINE AT OPERATING SPEED, TURN HIGH-SPEED NEEDLE VALVE CLOCKWISE UNTIL ENGINE RUNS UNEVENLY OR MISSES. TURN COUNTERCLOCKWISE UNTIL ENGINE SMOOTHS OUT AND REGAINS FULL SPEED.
- STEP 5. IDLE ENGINE.
- STEP 6. TURN IDLE ADJUSTMENT SCREW CLOCKWISE UNTIL ENGINE RUNS UNEVENLY. TURN COUNTERCLOCKWISE UNTIL ENGINE RUNS SMOOTHLY.
- STEP 7. TURN THROTTLE STOP SCREW IN AND OUT TO OBTAIN PROPER IDLING SPEED. EMC 4320-220-15/17

Figure 17. Carburetor adjustment.

Section VI. IGNITION SYSTEM

60. General

The ignition system consists of a high-tension magneto, magneto stop switch, spark plug, and cable. The magneto, driven off camshaft gear is fitted with an impulse coupling that provides a powerful spark for easy starting and retards the timing of the spark to eliminate danger of kickback.

61. Magneto

a. Test the magneto ignition spark as shown by figure 21.

b. Remove the end cover plate as shown by figure 22.

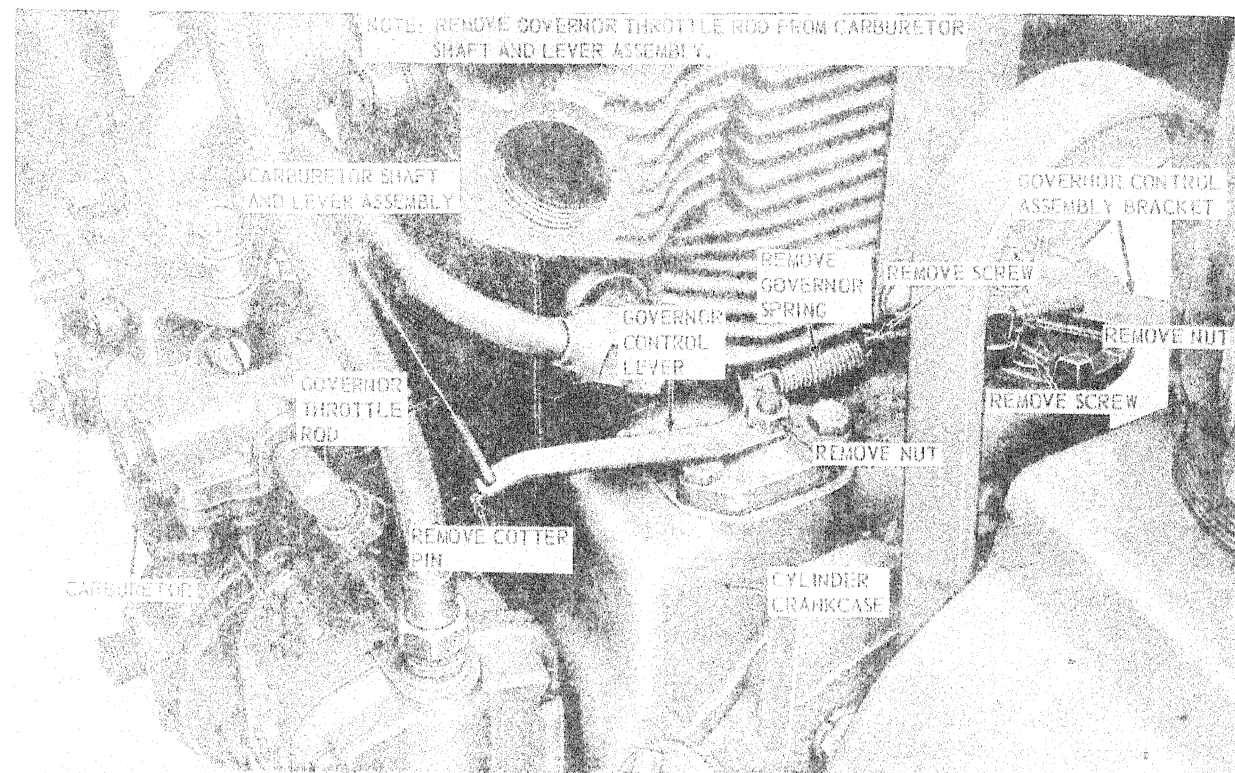
c. Remove and install the magneto contact set and capacitor as shown by figure 23.

d. Adjust the magneto contact points as shown by figure 23.

e. Remove the magneto as shown by figure 22.

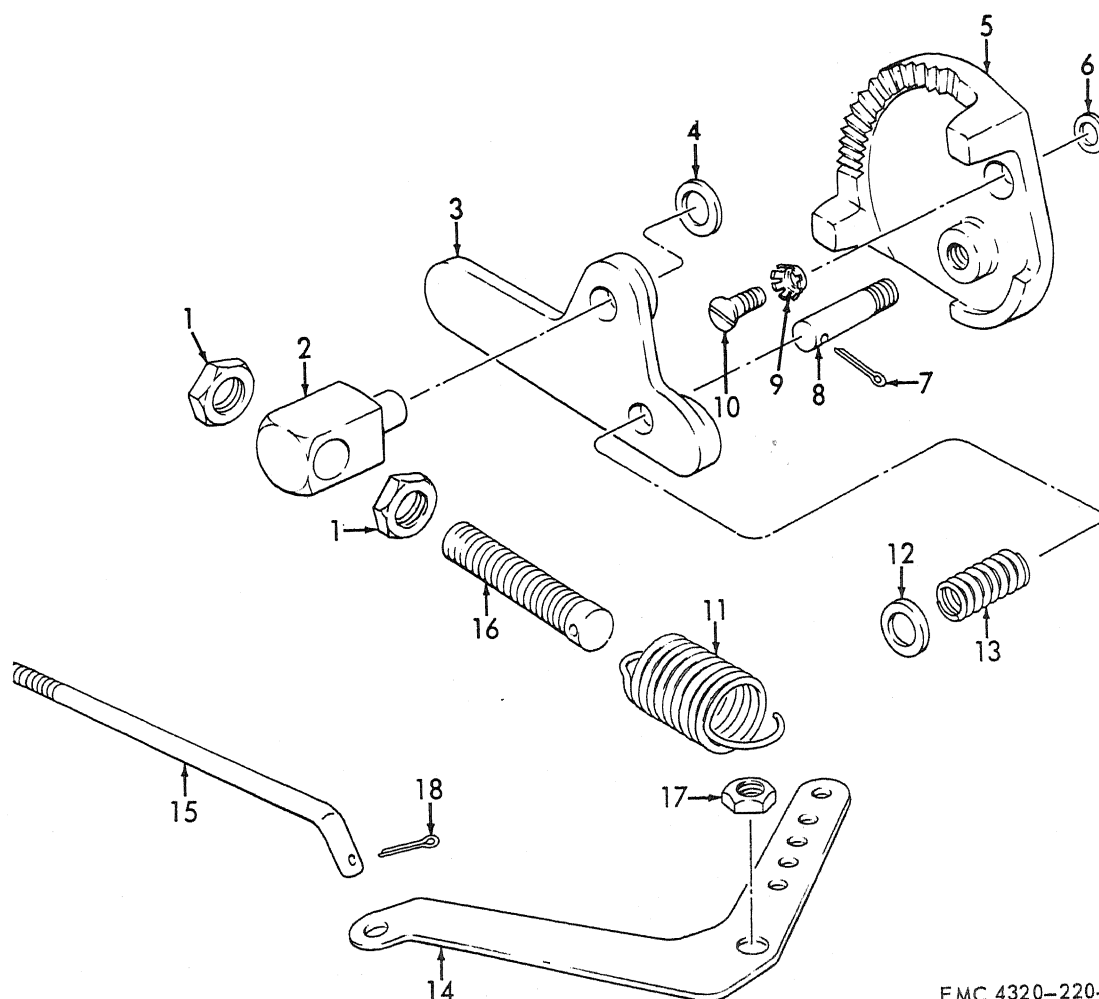
f. Service the magneto air vent as shown by figure 22.

g. Remove and install the magneto timing gear as shown by figure 24.



4. OPERATION CONTROL, ASSEMBLY LINKAGE, REMOVAL AND INSTALLATION

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- 1 Nut, hex, NO. 10-32 (2 rqr)
- 2 Adjusting screw block
- 3 Governor control lever
- 4 Washer, flat, 5/32 x 3/8 x 1/32 in.
- 5 Governor control bracket
- 6 Gasket
- 7 Pin, cotter, 1/16 x 1/2 in.
- 8 Lever support pin
- 9 Washer, lock, cask, 1/4 in.

- 10 Screw, machine, 1/4-20 x 5/8 in.
- 11 Spring
- 12 Washer, flat, 1/4 x 1/2 x 1/16 in.
- 13 Spring
- 14 Governor control lever
- 15 Governor throttle rod
- 16 Governor spring adjusting pin
- 17 Nut, hex, 1/4-28
- 18 Pin, cotter, 3/64 x 1/2 in.

Figure 19. Governor control assembly and linkage, disassembly and reassembly.

h. Aline the magneto timing marks as follows:

- (1) Remove the spark plug (par. 62).
- (2) Remove the flywheel shroud screen (par. 50).
- (3) Aline the magneto timing marks as

shown by figure 25.

i. Install the magneto as shown by figure 22.

j. Clean and inspect.

k. Perform field expedient repairs on the magneto stop switch by removing the stop switch and taping the end of the switch lead.

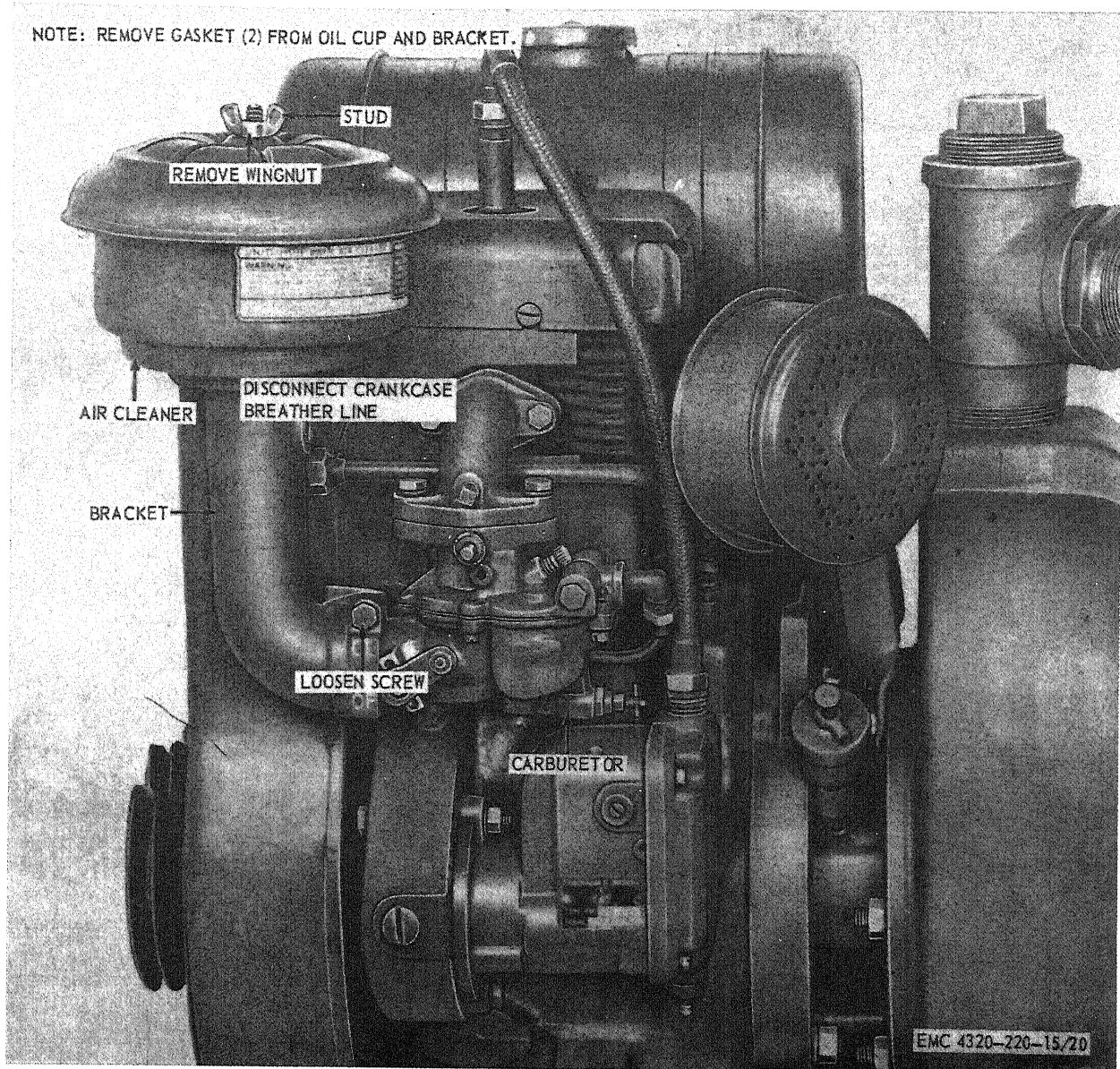


Figure 20. Engine air cleaner and bracket, removal and installation.

62. Spark Plug and Ignition Cable

a. Remove and install the spark plug and ignition cable as shown by figure 26.

b. Clean and inspect.

c. Perform field expedient repairs on the spark plug by bending the electrodes closer together.

Section VII. ENGINE AND ACCESSORIES

63. General

This unit is equipped with a single-cylinder 4-cycle, L-head, air-cooled, gasoline-driven engine mounted on two base rails. The engine is

manually started by use of a rope starting sheave. The sheave, located on the front of the engine, secures the flywheel on the crankshaft. The flywheel is a combination fan and flywheel

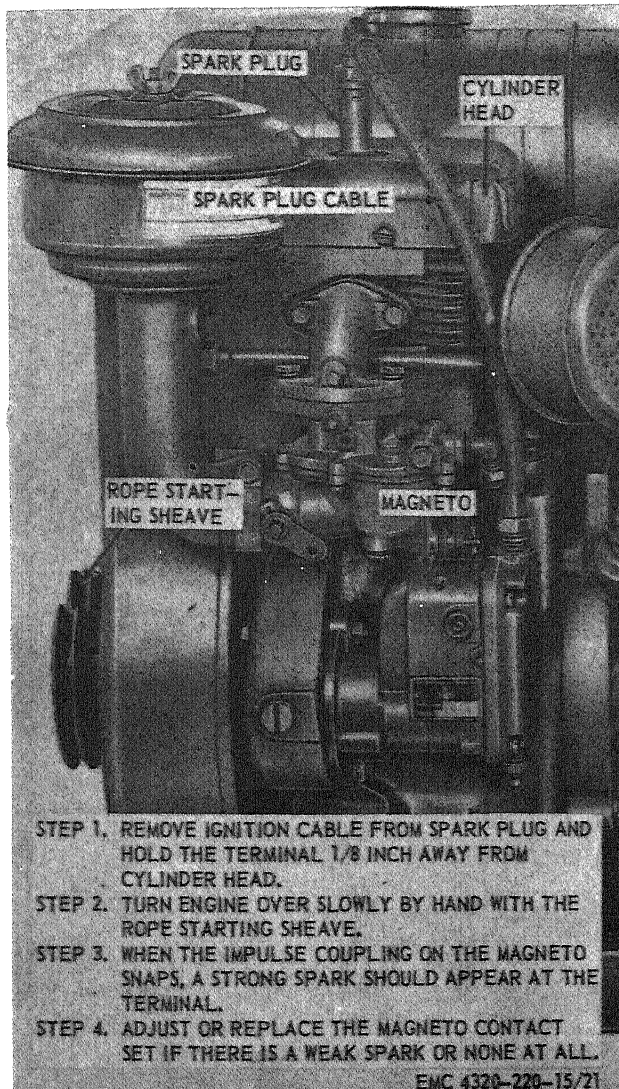


Figure 21. Testing magneto ignition spark.

and like the cylinder head, acts as an integral part of the engine cooling system. The engine utilizes a plunger-type oil pump, centrifugal, flyweight-type governor, and magneto ignition.

64. Rope Starting Sheave

- a. Remove and install the rope starting sheave shown by figure 27.
- b. Clean and inspect.

Section VIII. CENTRIFUGAL PUMP

69. General

The pump is a centrifugal-type unit that is directly coupled to the engine. The pump body

65. Flywheel

- a. Remove and install the rope starting sheave (par. 64).
- b. Remove and install the flywheel shroud rim and screen (par. 50).
- c. Remove and install the flywheel as shown by figure 28.
- d. Clean and inspect.

66. Cylinder Head

- a. Remove and install the spark plug and ignition cable (par. 62).
- b. Remove and install the cylinder head cover and spacer (par. 50).
- c. Remove and install the cylinder head as shown by figure 29.
- d. Tighten the cylinder head screws in proper sequence as shown by figure 30.
- e. Clean and inspect.
- f. Perform field expedient repairs on the cylinder head gasket by laying a piece of primary wire across the broken place and tightening down the cylinder head.

67. Intake and Exhaust Valves Inspection Cover Plate

- a. Remove and install the spark plug (par. 62).
- b. Remove and install the carburetor (par. 56).
- c. Remove and install the valves inspection cover plate as shown by figure 31.
- d. Clean and inspect.
- e. Adjust the valve lifters as shown by figure 31.

68. Engine and Base Rails

- a. Remove, disassemble, reassemble, and install the centrifugal pump (par. 70).
- b. Remove and install the engine and base rails as shown by figure 32.
- c. Clean and inspect.

houses the impeller and check valve and serves as a water chamber with suction and discharge ports. The check valve prevents fluid backflow through the pump body.

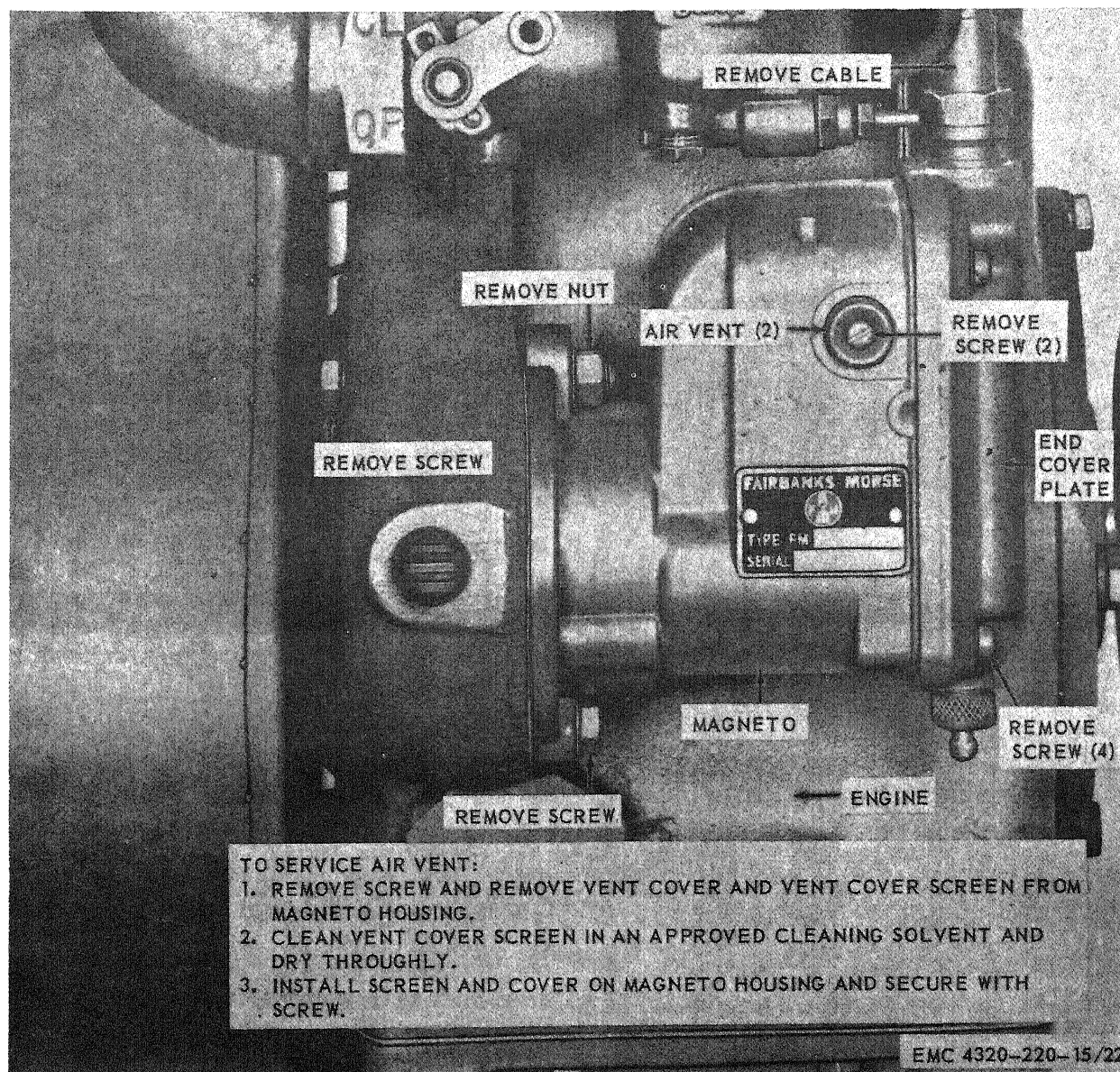


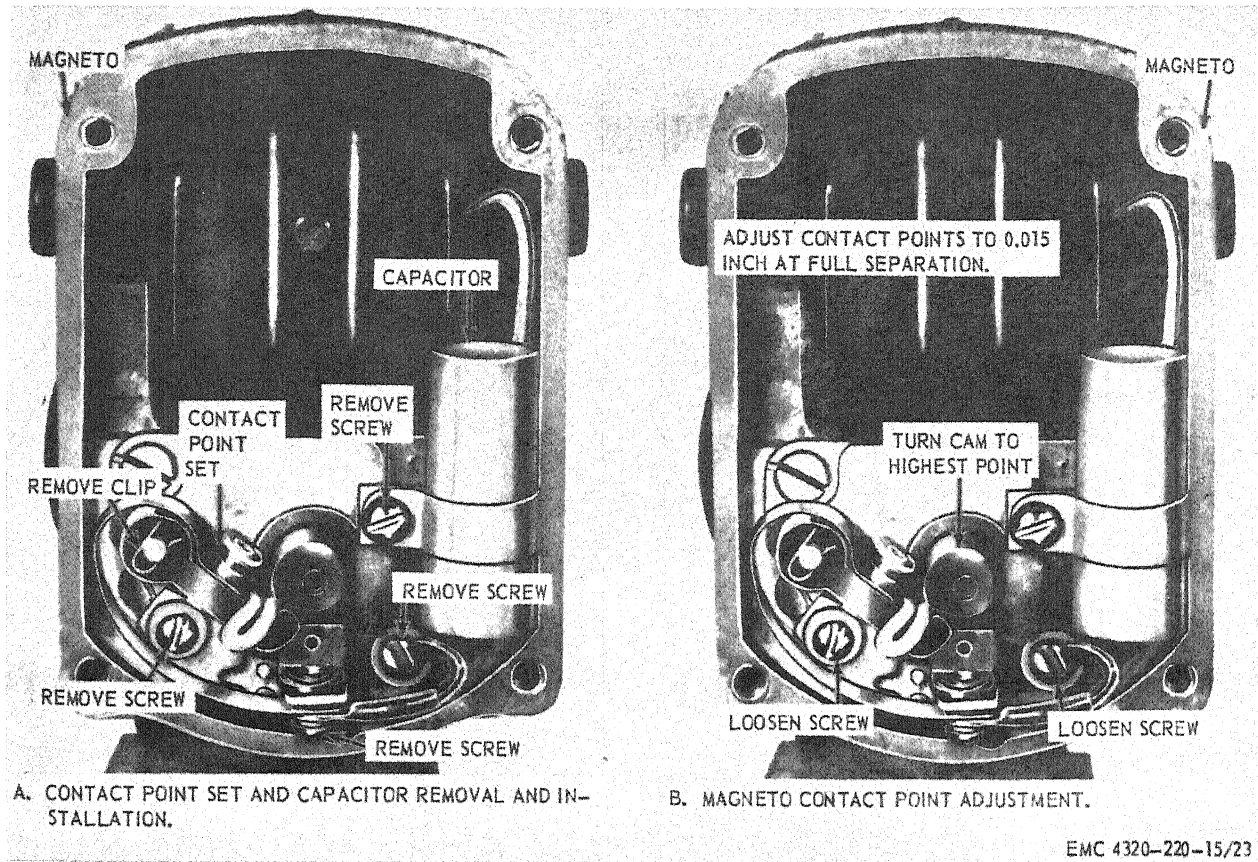
Figure 22. Magneto and end cover plate, removal and installation, and magneto air vent servicing.

70. Centrifugal Pump

a. Remove, disassemble, reassemble, and install the centrifugal pump as shown by figure 33.

Note. Disconnect the ignition cable from the spark plug before removing and disassembling the pump.

b. Clean, inspect, and repair.



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Figure 23. Magneto contact set and capacitor, removal and installation, and contact points adjustment.

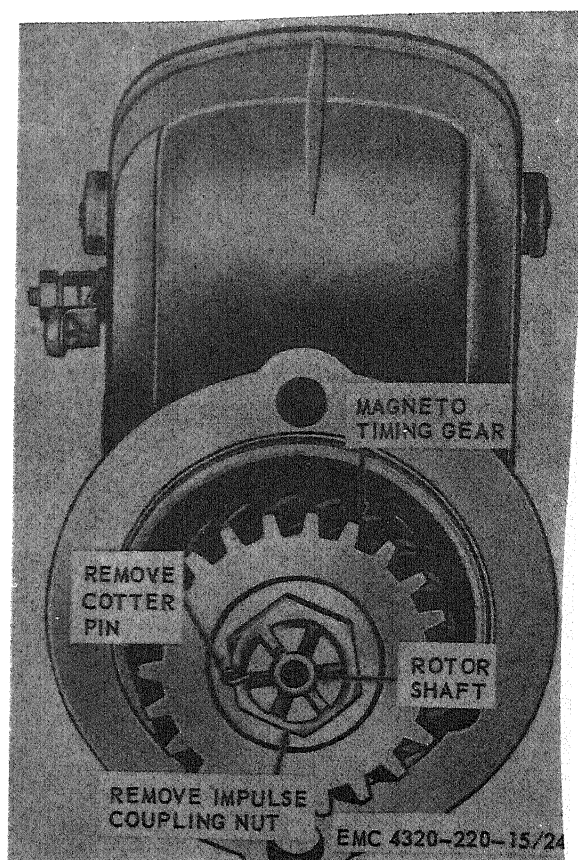


Figure 24. Magneto timing gear, removal and installati.

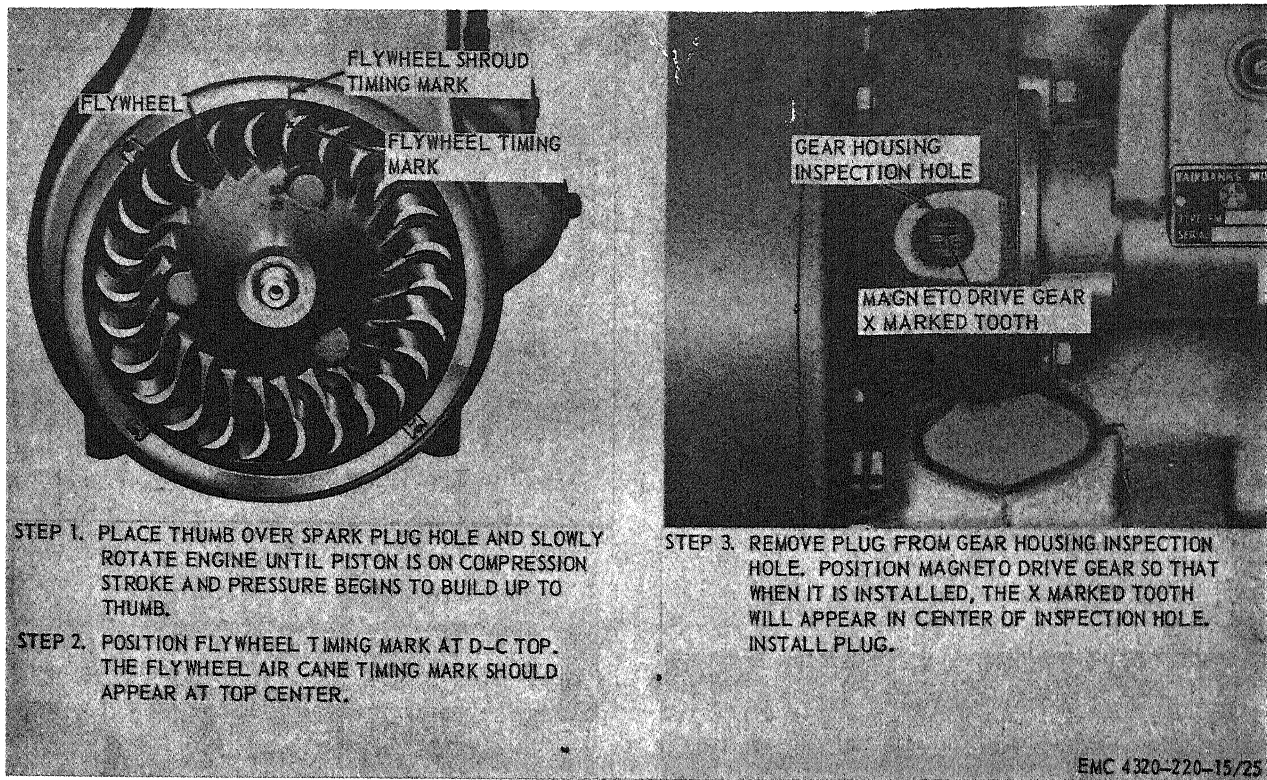


Figure 25. Magneto timing marks.

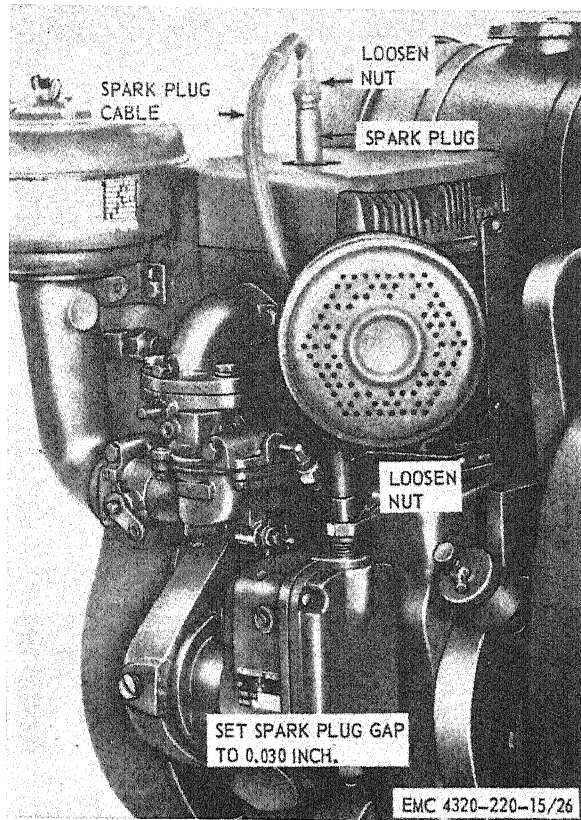


Figure 26. Spark plug and ignition cable, removal and installation.

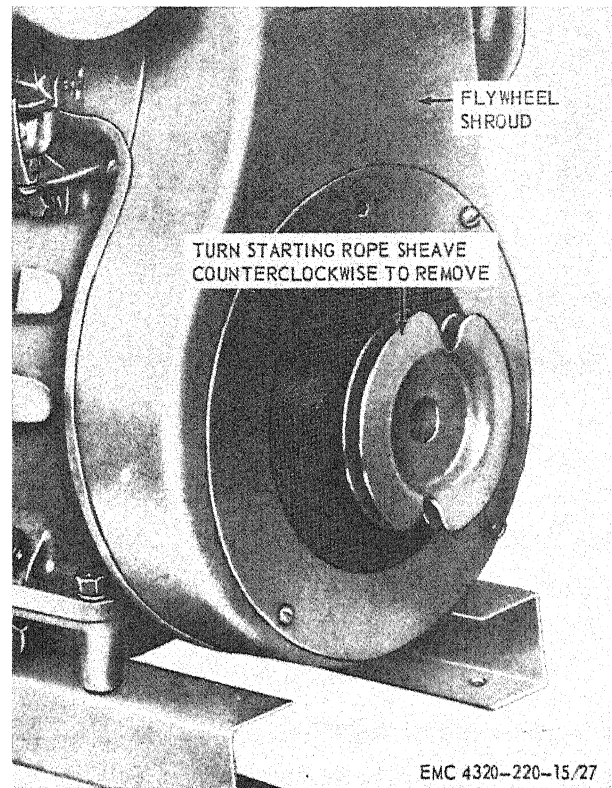


Figure 27. Rope starting sheave, removal and installation.

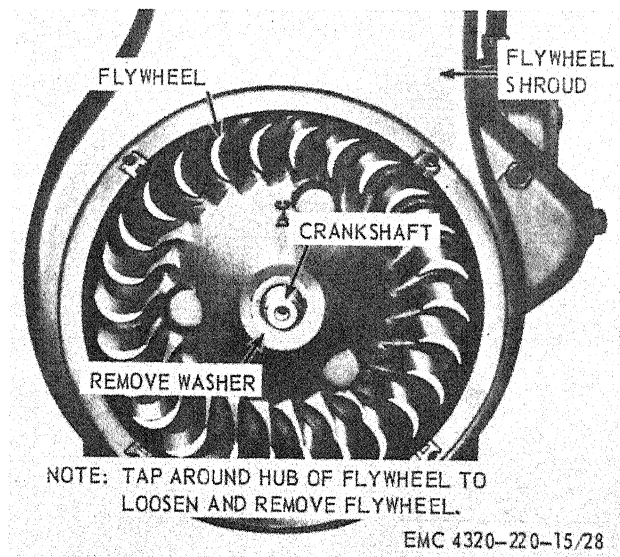


Figure 28. Flywheel, removal and installation.

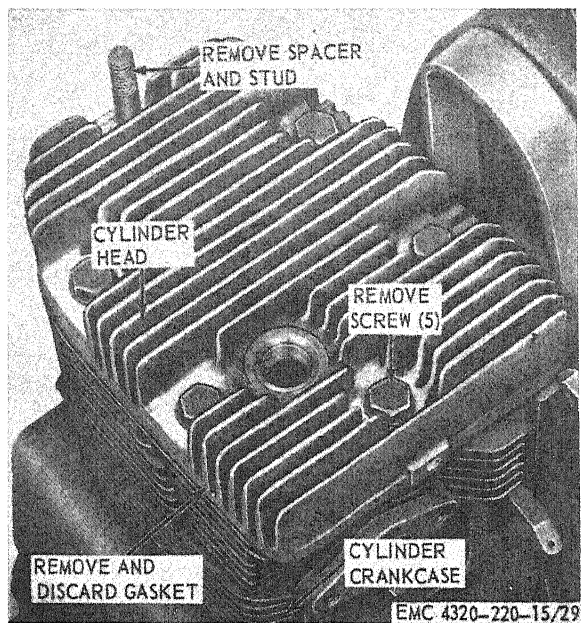


Figure 29 Cylinder head, removal and installation.

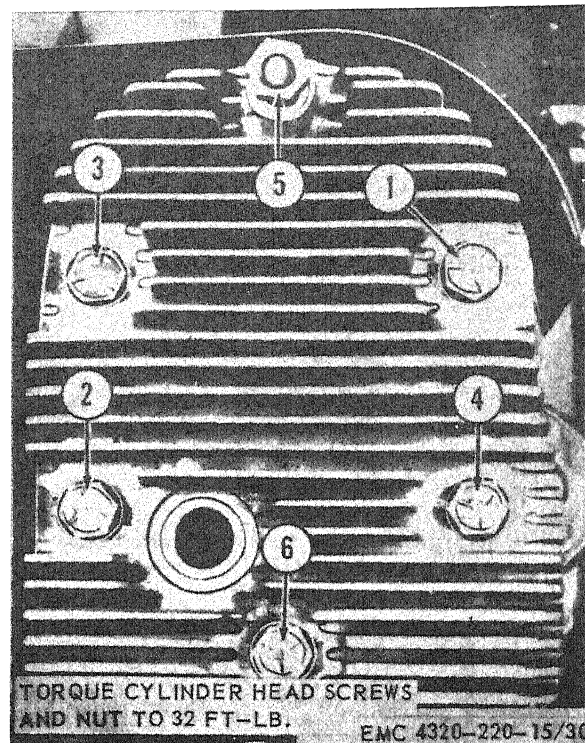


Figure 30. Cylinder head, tightening sequence.

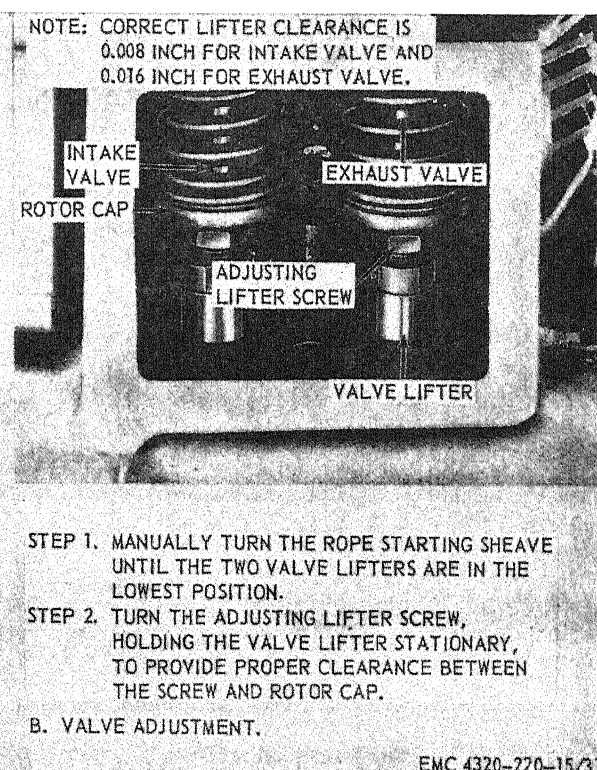
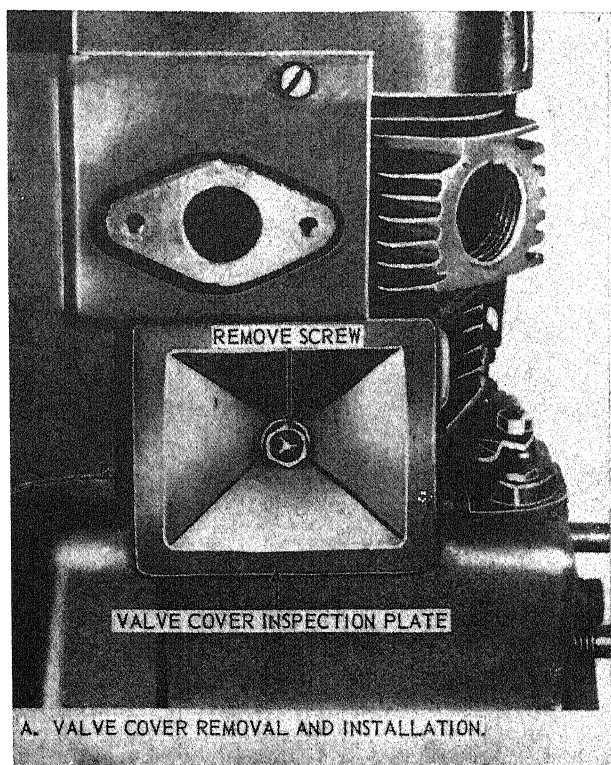


Figure 31. Intake and exhaust valves inspection cover plate, removal and installation. and valve lifters adjustment.

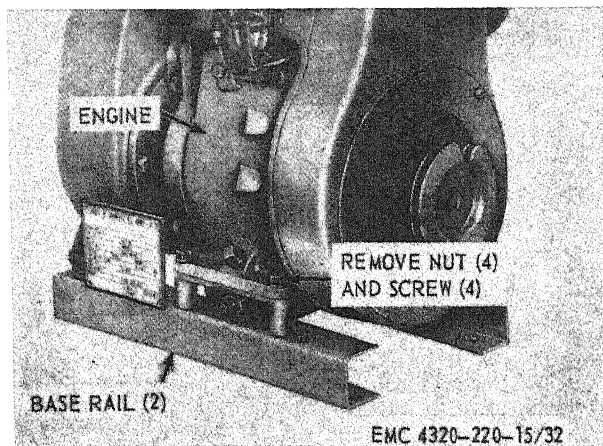
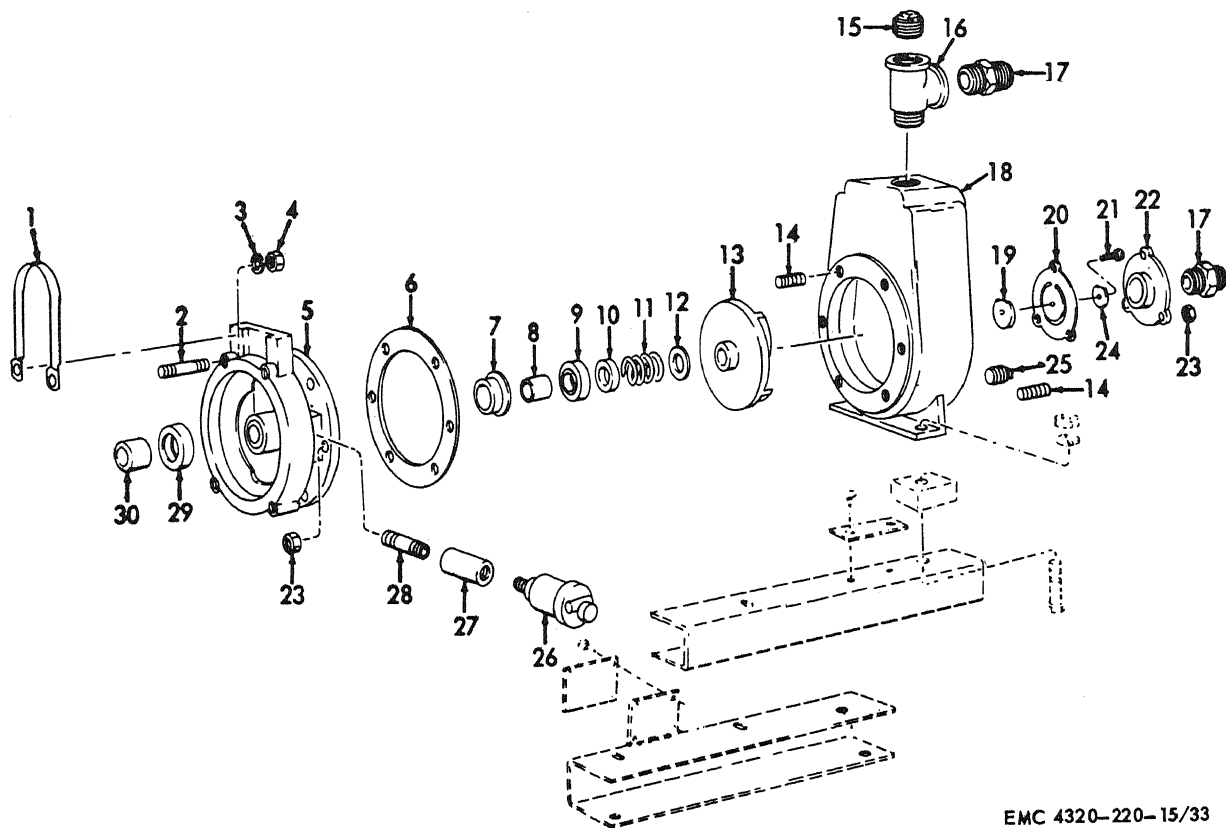


Figure 32. Engine and base rails, removal and installation.

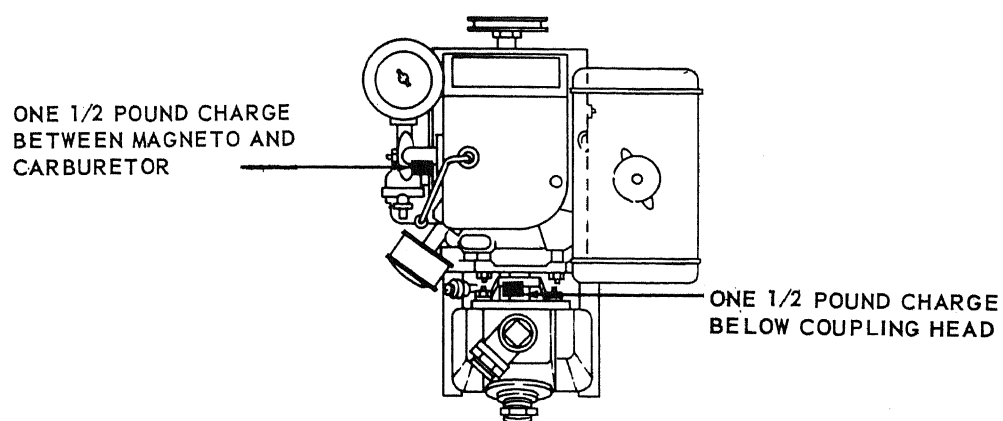


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Figure 33. Centrifugal pump, removal, disassembly, reassembly, and installation.

- | | |
|---|--|
| 1 Lifting handle | 16 Tee, pipe, 2-11- 1/2 in. |
| 2 Stud, plain, 7/16 x 2-1/2 in. | 17 Adapter (2 rqr) |
| 3 Washer, lock, 7/16 in, (4 rqr) | 18 Pump body |
| 4 Nut, hex, plain, 7/16-14 (4 rqr) | 19 Check valve weight |
| 5 Coupling head | 20 Check valve gasket |
| 6 Gasket | 21 Screw, machine, 1/4-20 x 5/8 in. |
| 7 Retaining ring | 22 Pipe flange |
| 8 Bushing | 23 Nut, hex, plain 3/8-16 in. (11 rqr) |
| 9 Rotating ring | 24 Check valve weight |
| 10 Nonmetallic washer | 25 Plug, pipe, 1-1/2-11-1/2 in. |
| 11 Spring | 26 Grease cup |
| 12 Washer, flat /in. | 27 Coupling pipe, 1/4-18 |
| 13 Impeller | 28 Nipple, pipe, 1/4-18 x 1-1/2 in. |
| 14 Stud, plain, 3/8-16 x 1-1/2 in. (9rqr) | 29 Seal |
| 15 Plug, pipe 2-11- 1/2 in. | 30 Bushing |

Figure 33—Continued.



LEGEND: ■ 1/2 POUND CHARGE

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Figure 34. Placement of charges.

CHAPTER 4

DEMOLITION OF THE CENTRIFUGAL PUMP TO PREVENT ENEMY USE

71. General

When capture or abandonment of the centrifugal pump to an enemy is imminent, the responsible unit commander must make the decision either to destroy the equipment or to render it inoperative. Based on this decision, orders are issued which cover the desired extent of destruction. Whatever method of demolition is employed, it is essential to destroy the same vital parts of all centrifugal pumps and all corresponding repair parts.

72. Demolition to Render the Centrifugal Pump Inoperative

a. Mechanical Means. Use an axe, sledge hammer, pick, pickmattock, or tools available to punch holes in the fuel tank and inflict severe damage to such items as the pump assembly carburetor, magneto, governor, engine crankcase, shroud, and manifold.

b. Misuse. Drain the engine crankcase. Pour sand, gravel, bolts, or broken glass into the fuel tank and pump priming hole. Run the engine until the centrifugal pump fails.

73. Demolition by Explosives or Weapons' Fire

a. Explosives. Place demolition charges as shown by figure 34 and detonate them simultaneously. Use as many of the charges listed in figure 34 as time permits.

- (1) One 1/2-pound charge between magneto and carburetor.
- (2) One 1/2-pound charge below coupling head.

b. Weapons' Fire. Fire on the centrifugal

pump with the heaviest practical weapons available.

74. Other Demolition Methods

a. Scattering and Concealment. Remove all easily accessible parts such as the air cleaner, carburetor, and magneto and scatter them through dense foliage, bury them in dirt or sand, or throw them in a lake, river, stream, or other body of water.

b. Burning. Pack rags, clothing, or canvas under or around the engine and pump assembly. Saturate this packing with gasoline, oil, or diesel fuel and ignite.

c. Submersion. Knock the spark plug base from the engine with any convenient tool and remove the oil drain plug. Completely submerge the centrifugal pump in a body of water to provide water damage and concealment. Salt water will do greater damage to metal parts than fresh water.

75. Training

All operators should receive thorough training in the destruction of the centrifugal pump. Refer to FM 5-25. Simulated destruction, using all of the methods listed above, should be included in the operator training program. It must be emphasized in training, that demolition operations are usually necessitated by critical situations when time available for carrying out destruction is limited. For this reason, it is necessary that operators be thoroughly familiar with all methods of destruction of equipment and be able to carry out demolition instructions without reference to this or any other manual.

CHAPTER 5

SHIPMENT AND LIMITED STORAGE

Section I. SHIPMENT WITHIN ZONE OF INTERIOR

76. Preparation of Equipment for Shipment

a. General. Detailed instructions for the preparation of Engineer equipment for domestic shipment are outlined within this paragraph. Preservation will be accomplished in sequence that will not require the operation of previously preserved components.

b. Inspection. Equipment will be examined for any unusual conditions such as damage, rusting, accumulation of water, and pilferage. DA Form 464, Work Sheet for Preventive Maintenance and Technical Inspection of Engineer Equipment, will be executed for the equipment.

c. Cleaning and Drying. Cleaning by an approved technique is the first essential procedure in any effective preservation process. Approved methods of cleaning, drying, types of preservatives and methods of application are described in TM 38-230.

d. Painting. Paint all surfaces when the paint has been removed or damaged. Refer to TB EN 60 for detailed cleaning and painting instructions.

e. Depreservation Guide.

- (1) A properly annotated Depreservation Guide will be completed concurrently with preservation for each item of mechanical equipment; any peculiar requirements will be outlined in the Remarks column. The completed Depreservation Guide will be placed in a waterproof envelope, marked "Depreservation Guide", and fastened in a conspicuous location on or near the operator's controls.
- (2) Prior to placing equipment in operation, or to the extent necessary for inspection, depreservation of the item

shall be performed as outlined on the Depreservation Guide.

f. Lubrication System. Check level of lubricant. Operate the engine at a fast idle until lubricant has been circulated throughout the system. Drain the crankcase and reinstall the drain plugs.

g. Sealing of Openings. Openings that will permit the direct entry of water into the interior of gasoline engine-driven equipment shall be sealed with waterproof, pressure-sensitive, adhesive tape conforming to Specification PPP-T-60, type III, class 1.

h. Fuel Tank. Drain fuel tank after engine preservation and fog interior with preservative oil (P-10) conforming to Specification MIL-L-21260, grade 2.

i. Air Cleaner. Drain the air cleaner and seal all openings that permit the direct entry of water. Use waterproof, pressure-sensitive adhesive tape conforming to PPP-T-60, type III, class 1.

j. Exposed Surfaces. Coat exposed machined ferrous metal surfaces with preservative (P-6) conforming with Specification MIL-C-11796, class 3. If preservative is not available, cup grease may be used.

k. Marking. Marking shall conform to MIL-STD-129.

l. Pumps. Spray interior of pump with preservative oil (P-3) conforming to MIL-C-16173 grade 3, except preservative oil (P-14) conforming to MIL-C-10382 shall be used for pumps used in portable water systems. Seal openings that will permit the direct entry of water with waterproof, pressure-sensitive adhesive tape conforming to PPP-T-60 type III,

class 1.

m. Disassembly, Disassembled Parts and Basic Issue Items.

- (1) Disassembly shall be limited to the removal of parts and projecting components that tend to increase the overall profile of the equipment and to those subject to damage or pilferage.
- (2) Disassembled items shall be packed with the publications in the tool box if possible. Otherwise items will be packed in a suitable container and se-

cured to the equipment to prevent loss or pilferage.

n. Packing. If packing is required to provide adequate protection against damage during shipment, refer to TM 38-230 for guidance in crate fabrication.

77. Loading Equipment for Shipment

Load the centrifugal pump on the carrier by using a handtruck, forklift, or manpower, and block or tie it down to prevent shifting during transportation.

Section II. LIMITED STORAGE

78. Preparation of Equipment for Storage

a. General. Limited storage is defined as a period not to exceed 6 months. Detailed instructions for preparation of this equipment for limited storage are listed in this paragraph. Refer to AR 743-505 for additional information.

b. Inspection. Make a complete inspection of the centrifugal pump as described in paragraph 9. Correct all deficiencies as necessary or report to field maintenance.

c. Cleaning and Drying. As outlined in paragraph 76.

d. Painting. As outlined in paragraph 76.

e. Depreservation Guide. Will be completed as outlined in paragraph 76.

f. Lubrication System. As outlined in paragraph 76, except crankcase will not be drained for limited storage.

g. Sealing of Openings. As outlined in paragraph 76.

h. Fuel Tank. As outlined in paragraph 76.

i. Exterior Surfaces. As outlined in paragraph 76.

j. Pump Interior. As outlined in paragraph 76.

k. Disassembly. Disassembled Parts, and Basic Issue Items. Will be preserved and packaged as outlined in paragraph 76.

l. Weather-proofing. When suitable shelter is not available, select a firm, level, well-drained storage location, protected from prevailing winds.

Position the equipment on heavy planking or other solid surfaces. Cover the equipment with a tarpaulin or other suitable waterproof covering and tie down securely.

79. Inspection and Maintenance of Equipment in Storage

a. Inspection. When equipment has been placed in storage, all scheduled preventive maintenance services including inspection will be suspended and preventive maintenance inspection will be performed as specified herein. Refer to AR 743-505.

b. Worksheet and Preventive Maintenance. DA Form 464 will be executed on each major item of equipment when equipment is initially placed in storage and every 30 days thereafter. Required maintenance will be performed promptly to insure that the equipment is mechanically sound and ready for immediate use.

c. Exercising. Equipment in limited storage must be operated long enough to bring it up to operating temperature and for complete lubrication of all bearings, gears, and the like, at least every 30 days. Equipment must be serviced and in satisfactory operating condition before it is operated. After each exercising period equipment will be represerved as outlined in paragraph 78.

CHAPTER 6

FIELD AND DEPOT MAINTENANCE REPAIR INSTRUCTIONS

Section I. GENERAL

80. Scope

a. The following instructions are provided for the use of field and depot maintenance personnel. They contain information on the maintenance of the equipment which is beyond the scope of the tools, equipment, personnel, or supplies normally available to organizational maintenance facilities.

b. Appendix I contains a list of all publications applicable to field and depot maintenance

facilities for this equipment. Appendix II contains the Maintenance Allocation Chart.

81. Field and Depot Maintenance Record and Report Forms

For record and report forms applicable to third, fourth, and fifth echelons of maintenance refer to TM 5-505, Maintenance of Engineer Equipment.

Section II. DESCRIPTION AND DATA

82. Description

For a complete description of the centrifugal pump, refer to paragraph 3.

83. Field and Depot Maintenance Tabulated Data

a. Nut and Bolt Torque Data.

Engine base screws	7 to 9 ft-lb
Connecting rod nuts	18 ft-lb
Crankshaft main bearing plate screws	26 to 32 ft-lb
Pump base screws	7 to 9 ft-lb

b. Adjustment Data.

Valve lifter (intake and exhaust)	
Engine cold (intake)	0.008 in.
Engine cold (exhaust)	0.016 in.

c. *Engine Repair and Replacement Standards.* Table II lists manufacturer's sizes, tolerances, clearances, and the maximum allowable wear and clearances for the Wisconsin Engine, Model MAENLD.

d. *Time Standards.* Table III lists the number of man-hours required under normal conditions for various operations in the maintenance and repair of the centrifugal pump. The man-hours listed are not intended to be rigid standards. Under adverse conditions, the operations will take considerably longer; whereas, under ideal conditions with highly skilled mechanics, most of the operations can be accomplished in considerably less time.

Table II. Engine Repair and Replacement Standards

	Manufacturer's dimensions and tolerances inches		Desired clearance		Maximum allowable wear in inches	Maximum allowable clearance in inches
	Min	Max	Min	Max		
<i>Cylinder</i>						
Cylinder bore -----	3.000	3.003				0.003
Cylinder taper -----	0.003	0.0035				
Cylinder out of round -----		0.0005				
<i>Crankshaft</i>						
Journal width -----	1.250	1.255				
Journal diameter main bearing -----	1.325					
Journal diameter (rod) -----	1.125	1.126				0.002
Journal taper -----		0.0005				
Journal out of round -----		0.0005				
Runout, flywheel end -----		0.007				
End play -----			0.001	0.003		
	(Engine cold)					
Journal shoulder fillet radius -----	0.125					
Crankshaft length -----	14.625					
<i>Camshaft</i>						
Support pin length -----	6.625					
Support pin diameter -----	0.490					
<i>Piston and Pin</i>						
Piston skirt clearance -----			0.003	0.0035		
Piston diameter -----	2.995	3.000				0.0005
Piston pin length -----	2.5625					
Piston pin diameter -----	0.749	0.750				0.001
Piston to rod bushing clearance -----		0.0005	0.001			
<i>Piston Rings</i>						
End gap (when fitted in cylinder) -----		0.012	0.022			
To groove (total both sides) -----						
Top compression ring to groove -----			0.002	0.0035		
Two compression and scraper rings -----			0.001	0.0025		
Oil ring -----			0.0025	0.004		
<i>Spark</i>						
Advance (ahead of top dead center) --		20°				
<i>Connecting Rod Bearing</i>						
Rod bearing inside diameter -----	1.12670	1.12700				
<i>Connecting Rod Sleeve Bearing</i>						
Inside diameter -----	0.0495	0.750				0.0005
Sleeve bearing length -----	1.127					
<i>Connecting Rod Bearing</i>						
End play (side clearance) -----			0.004	0.010		
Bearing to journal clearance -----			0.007	0.002		
<i>Connecting Rod</i>						
Center to center -----	8.000					
<i>Valves, Valve Guides, and Valve Lifters</i>						
Valve head diameter -----	1.250					
Valve stem diameter -----	0.3080	0.3090				0.002
Valve stem to guide -----			0.003	0.005		0.007
Valve guide inside -----	0.3120	0.3130				0.002

Table II. Engine Repair and Replacement Standards—Continued

	Manufacturer's dimensions and tolerances inches		Desired clearance		Maximum allowable wear in inches	Maximum allowable clearance in inches
	Min	Max	Min	Max		
<i>Valves, Valve Guides, and Valve Lifters (Cont'd)</i>						
Lifter diameter -----	0.648					0.002
Lifter clearance in guide -----			0.001	0.0025		
Lifter length overall -----	3.125					
<i>Camshaft</i>						
Camshaft support pin diameter -----	0.4900	0.4905				0.002
Camshaft and gear inside diameter ----	0.4920	0.4930				0.002
<i>Oil Pump</i>						
Plunger-to-bore -----	0.003	0.004				
Plunger diameter -----	0.625					
Plunger length -----	0.940					
Rod diameter -----	0.247					
Rod length -----	4.5625					
<i>Pump, Water</i>						
Impeller-to-body face clearance -----			0.005	0.015		

Table III. Time Standards

<i>Lubrication and Service</i>		<i>Hours</i>	<i>Lubrication and Service</i>		<i>Hours</i>
01 ENGINE					
0100 ENGINE ASSEMBLY			0101 CRANKCASE, BLOCK, CYLINDER HEAD		
Engine assembly, gasoline (drain and refill with new oil) -----		0.3	Head, cylinder (include removal and installation of spark plug and cover) -----		0.5
03 FUEL SYSTEM			Cylinder and crankcase assembly (engine removed) (include removal and installation of head, carburetor, magneto, flywheel and housing --		6.0
0304 AIR CLEANER					
Air cleaner, intake (clean and refill with new oil) -----		0.1	0102 CRANKCASE		
0306 TANKS, LINES, FITTINGS			Crankcase assembly (engine removed) (includes removal and installation of base, head, air shroud and flywheel) -----		3.5
Tank, fuel assembly (drain and flush tank) -----		0.2	0103 FLYWHEEL ASSEMBLY		
0309 FUEL FILTERS			Flywheel, crankshaft (includes removal and installation of starting pulley and screen) -----		0.5
Strainer assembly (clean strainer) -----		0.2	0104 PISTONS, CONNECTING RODS		
05 COOLING SYSTEM			Piston, internal combustion engine (includes removal and installation of head cylinder and base oil pan) -----		3.0
0502 COWLING, DEFLECTORS, AIR DUCT, SHROUD					
Screen (cleaning) -----		0.1			
55 PUMPS (EXCLUDE ENGINE PUMPS)					
5505 LUBRICATORS					
Cup, grease (refill grease cup) -----		0.1			
Remove and Replace					
01 ENGINE					
0100 ENGINE ASSEMBLY					
Engine assembly, gasoline (includes removal and installation of pump body, impeller and head coupling ----		3.0			

Table III. Time Standards—Continued

	Hours		Hours
		0308	ENGINE SPEED GOVERNOR
			Flyweight assembly
			(engine removed) (includes
			removal and installation
			of camshaft) ----- 4.5
0105.1	VALVES	0308.4	GOVERNOR CONTROLS
	Valve and insert		Control assembly ----- 0.3
	(includes removal and	0309	FUEL FILTERS
	installation of carburetor		Strainer assembly ----- 0.3
	and head cylinder) ----- 3.0	04	EXHAUST SYSTEM
	Pin, hollow	0401	MUFFLER AND PIPES
	(includes removal and		Muffler, exhaust ----- 0.1
	installation of carburetor	05	COOLING SYSTEM
	and head cylinder) ----- 2.5	0502	COWLING, DEFLECTORS,
0105.2	ROCKER ARMS, TAPPETS		AIR DUCT, SHROUD
	Lifter, valve		Shroud
	(engine removed) (includes		(include removal and
	removal and installation		installation of pulley,
	of base oil pan, governor		flywheel and screen guard ---- 0.6
	and crankshaft and camshaft)	06	ELECTRICAL SYSTEM
	(includes adjustment) ----- 6.1	0604.2	MAGNETO ASSEMBLY
0105.3	CAMSHAFTS		Magneto, ignition
	Camshaft assembly		(includes retiming engine) ----- 0.6
	(engine removed) (includes	0604.6	IGNITION COIL: WIRING,
	removal and installation		SPARK PLUGS
	of crankshaft, rod, connecting		Spark plug ----- 0.1
	base oil pan valves		Cable assembly ----- 0.1
	and cylinder head) ----- 4.0	55	PUMPS (EXCLUDE ENGINE PUMPS)
0105.5	TIMING GEARS	5500	PUMP ASSEMBLY
	Gear, helical		Pump, centrifugal
	(engine removed) (include		(includes removal and
	removal and installation		installation of engine
	of magneto crankshaft		assembly and base rails) ----- 3.0
	and camshaft ----- 4.6	5501	VOLUTE, HOUSING
0106.1	OIL PUMP		Body, pump ----- 0.6
	Body assembly	5502	IMPELLER; ROTOR, DIAPHRAGM
	(include removal and		Impeller, pump, centrifugal
	installation of base		(includes removal and
	oil pan ----- 1.0		installation of pump body) ---- 0.7
0106.5	CRANKCASE VENTILATION		Seal, shaft, assembly
	Line assembly, air breather ---- 0.1		(includes removal and
0106.6	OIL PANS, LINES, LEVEL		installation of pump
	GAGE		body and impeller) ----- 1.0
	Base, engine ----- 0.5	5504	DISCHARGE ASSEMBLY
0108	MANIFOLDS		Adapter ----- 0.1
	Manifold, intake	5504.2	SUCTION VALVE, SUCTION
	(include removal and		HEADS
	installation of carburetor ---- 0.5		Valve, lift, check ----- 0.5
03	FUEL SYSTEM	5504.3	PRIMING DEVICES
0301	CARBURETOR; FUEL		Plug, pipe ----- 0.1
	INJECTOR	5505	LUBRICATORS
	Carburetor, float ----- 0.4		Cup, grease ----- 0.2
0304	AIR CLEANER		
	Air cleaner, intake ----- 0.1		
0306	TANKS, LINES, FITTINGS		
	Tank assembly, fuel ----- 0.3		

Note. No special tools or equipment are required for the maintenance of the centrifugal pump by field and depot maintenance personnel.

Section III. FIELD AND DEPOT MAINTENANCE TROUBLESHOOTING

84. General

This section provides information useful in diagnosing and correcting unsatisfactory operation or failure of the centrifugal pump or its components. Each trouble symptom stated is followed by a list of probable causes of trouble. The possible remedy recommended is described opposite the probable cause.

85. Engine Is Hard to Start or Fails to Start

<i>Probable cause</i>	<i>Possible remedy</i>
Magneto defective -----	Repair the magneto (par. 94).
Compression weak -----	Repair or replace the defective valves (par. 98). Replace the defective piston rings (par. 100).

86. Engine Misses or Runs Erratically

<i>Probable cause</i>	<i>Possible remedy</i>
Magneto defective -----	Repair the magneto (par. 94).
Valves defective -----	Repair or replace the valves (par. 98.)
Governor defective -----	Repair or replace the governor (par. 106).

87. Engine Knocks

<i>Probable cause</i>	<i>Possible remedy</i>
Crankshaft cones and rollers defective. -----	Replace the cones and rollers (par. 104).
Connecting rod loose -----	Replace the connecting rod (par. 100).
Piston worn -----	Replace the piston (par. 100).
Cylinder bore worn excessively. -----	Replace the cylinder crankcase (par. 108).
Piston pin loose -----	Replace the connecting rod bushing (par. 100).
Valve lifters loose -----	Replace the valve lifters (par. 98).

88. Engine Exhaust Smoky

<i>Probable cause</i>	<i>Possible remedy</i>
Piston or rings worn -----	Replace the piston and/or rings (par. 100).

<i>Probable cause</i>	<i>Possible remedy</i>
Cylinder bore worn or scored -----	Replace the cylinder crankcase (par. 108).

89. Engine Overheats

<i>Probable cause</i>	<i>Possible remedy</i>
Oil pump defective -----	Repair or replace the oil pump (par. 96).

90. Engine Backfires

<i>Probable cause</i>	<i>Possible remedy</i>
Intake valve sticking -----	Repair or replace the valve (par. 98).
Intake valve spring defective -----	Replace the spring (par. 98.)

91. Engine Lacks Power

<i>Probable cause</i>	<i>Possible remedy</i>
Magneto defective -----	Repair the magneto (par. 94).
Compression weak -----	Replace the pistons (par. 100). Replace the rings (par. 100). Replace the cylinder crankcase (par. 108). Repair or replace the defective valves (par. 98).
Governor defective -----	Repair or replace the governor (par. 106).

92. Engine Stops Suddenly

<i>Probable cause</i>	<i>Possible remedy</i>
Piston damaged -----	Replace the piston (par. 100).
Connecting rod broken -----	Replace the connecting rod (par. 100).
Crankshaft broken -----	Replace the crankshaft (par. 104).
Engine jumps time -----	Replace the camshaft and camshaft gears (pars. 98 and 104).

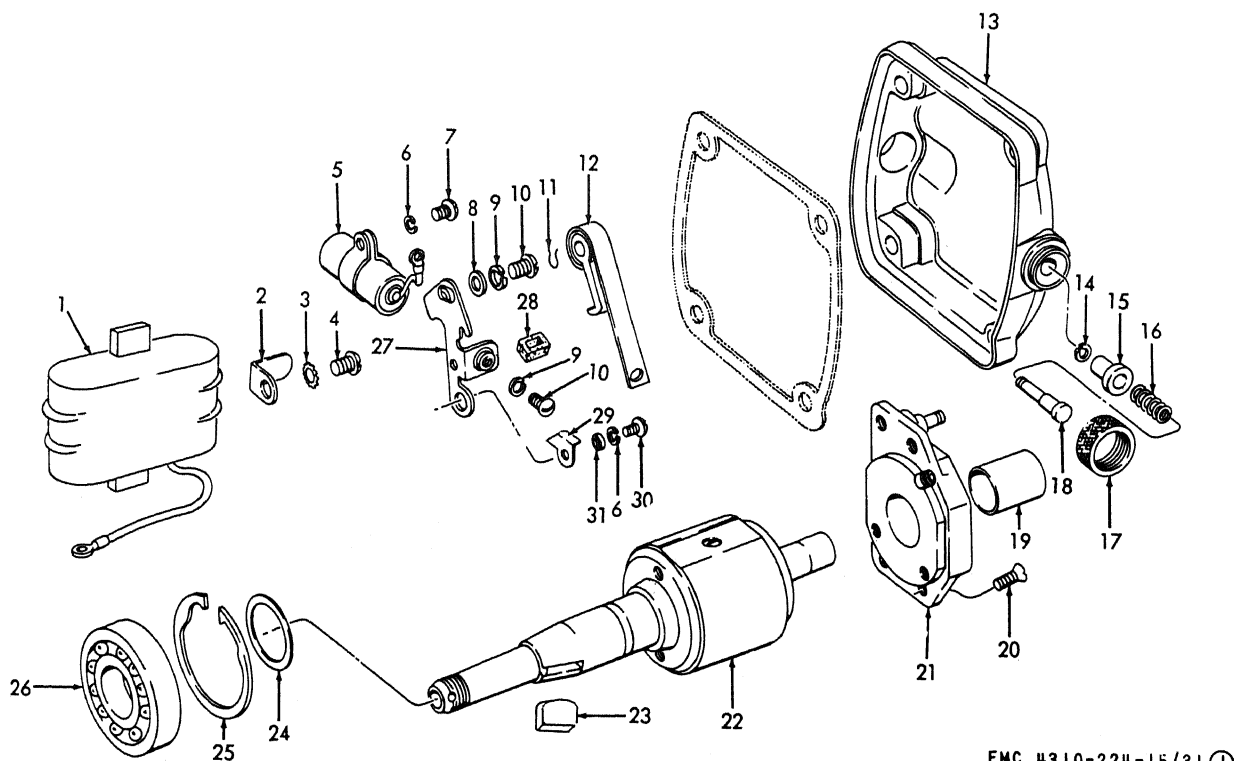
Section IV. MAGNETO

93. General

The main function of the magneto is to supply high-voltage current for the engine ignition system. The magneto consists of the contact set, capacitor, coil, magneto rotor, and impulse coupling. The contact set which provides a timed spark for ignition is actuated by the magnetic rotor. The impulse coupling is used to provide increased speed of the armature for starting the engine.

94. Magneto

- a. Remove and install the magneto (par. 61).
- b. Disassemble and reassemble the magneto as shown by figure 35.
- c. Align the magneto drive gear as shown by figure 25.
- d. Clean, inspect, and repair.
- e. Test the magneto coil on an ignition tester. Replace a defective coil.



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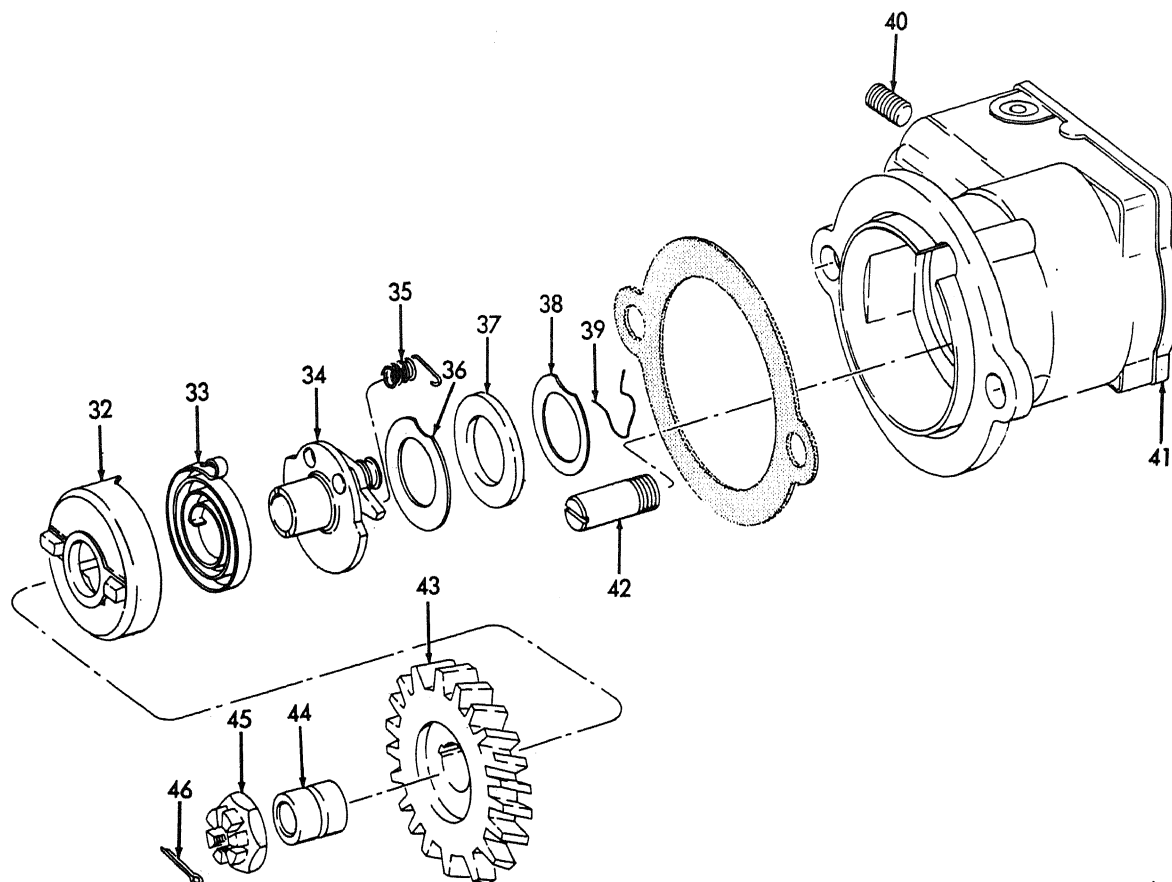
- 1 Magneto coil
- 2 Coil clip
- 3 Washer, lock, No. 6

- 4 Screw, machine, No. 6-32 x 3/16 in.
- 5 Capacitor
- 6 Washer, lock, No. 8 (2 rqr)

Figure 35. Magneto, disassembly and reassembly.

- | | |
|---|---|
| 7 Screw, machine, No. 8-32 x 1/4 in. | 20 Screw, machine, No. 8-32 x 3/8 in. |
| 8 Washer, flat, brass, 9/64 in. id, 9/32 in. od, 1/64 in. thk | 21 Bearing support plate assembly |
| 9 Washer, lock, No. 6 (2 rqr) | 22 Magnetic rotor |
| 10 Screw, machine, No. 6-32 x 3/8 in. (2 rqr) | 23 Key, woodruff, No. 3 |
| 11 Fulcrum retaining ring | 24 Shim (2 rqr) |
| 12 Breaker arm and spring | 25 Retaining ring |
| 13 Ignition shield | 26 Annular ball bearing |
| 14 Ground switch retaining ring | 27 Contact set support plate |
| 15 Bushing | 28 Breaker arm flat wick |
| 16 Spring | 29 Cam wick holder |
| 17 Knurled nut | 30 Screw, machine, No. 8-32 x 3/8 in. |
| 18 Pushbutton | 31 Washer, flat, 5/32 in. id, 3/8 in. od, 0.049 in. thk |
| 19 Sleeve bearing | |

Figure 35—Continued.



EMC 4310-224-15/31 (2)

- | | |
|-------------------|-------------------|
| 32 Coupling shell | 34 Hub assembly |
| 33 Drive spring | 35 Torsion spring |

Figure 35—Continued.

- 36 Washer, flat, outer end, 5/8 in. id, 1-3/8 in. od, 1/32 in. thk
- 37 Plain seal
- 38 Washer, flat, inner end, 23/32 in. id, 1-17/64 in. od, 0.015 in. thk
- 39 Retaining ring
- 40 Setscrew, headless, 1/4-20 x 7/8 in. (2 rqr)

- 41 Magneto fame
- 42 Pawl stop pin
- 43 Drive gear
- 44 Sleeve bearing
- 45 Sleeve nut
- 46 Pin, cotter, 3/32 x 3/4 in.

Figure 35—Continued.

Section V. ENGINE BASE AND OIL PUMP

95. General

a. Engine Base. The engine base supports the engine and forms the bottom of the crankcase. The base holds the engine lubricating oil. It is provided with an engine mounting base at each of the four corners and is fastened to the crankcase by a series of cap screws and lockwashers. Gasket paper between the base and the lower part of the crankcase provides a seal to prevent oil from leaking out of the crankcase.

b. Oil Pump. The oil pump is a plunger-type unit, mounted on the lower inside of the cylinder crankcase. It is operated by a cam-actuated plunger rod. The pump draws oil from the engine base and sprays it on the internal working components of the engine.

96. Engine Base and Oil Pump

- a.* Drain the oil from the engine crankcase.
- b.* Remove the oil from the engine air cleaner.
- c.* Remove and install the engine (par. 68).
- d.* Turn the engine on its side and remove and install the engine base as shown by figure 36.
- e.* Remove and install the oil pump as shown by figure 37.
- f.* To remove the push rod, remove and install the camshaft (par. 106).
- g.* Disassemble and reassemble the oil pump as shown by figure 38.
- h.* Clean, inspect, and repair.

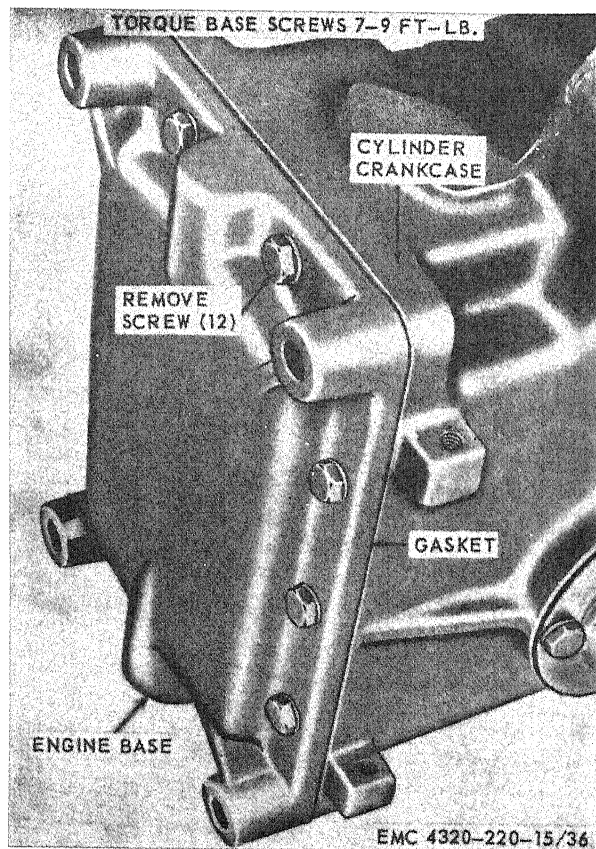


Figure 36. Engine base, removal and installation.

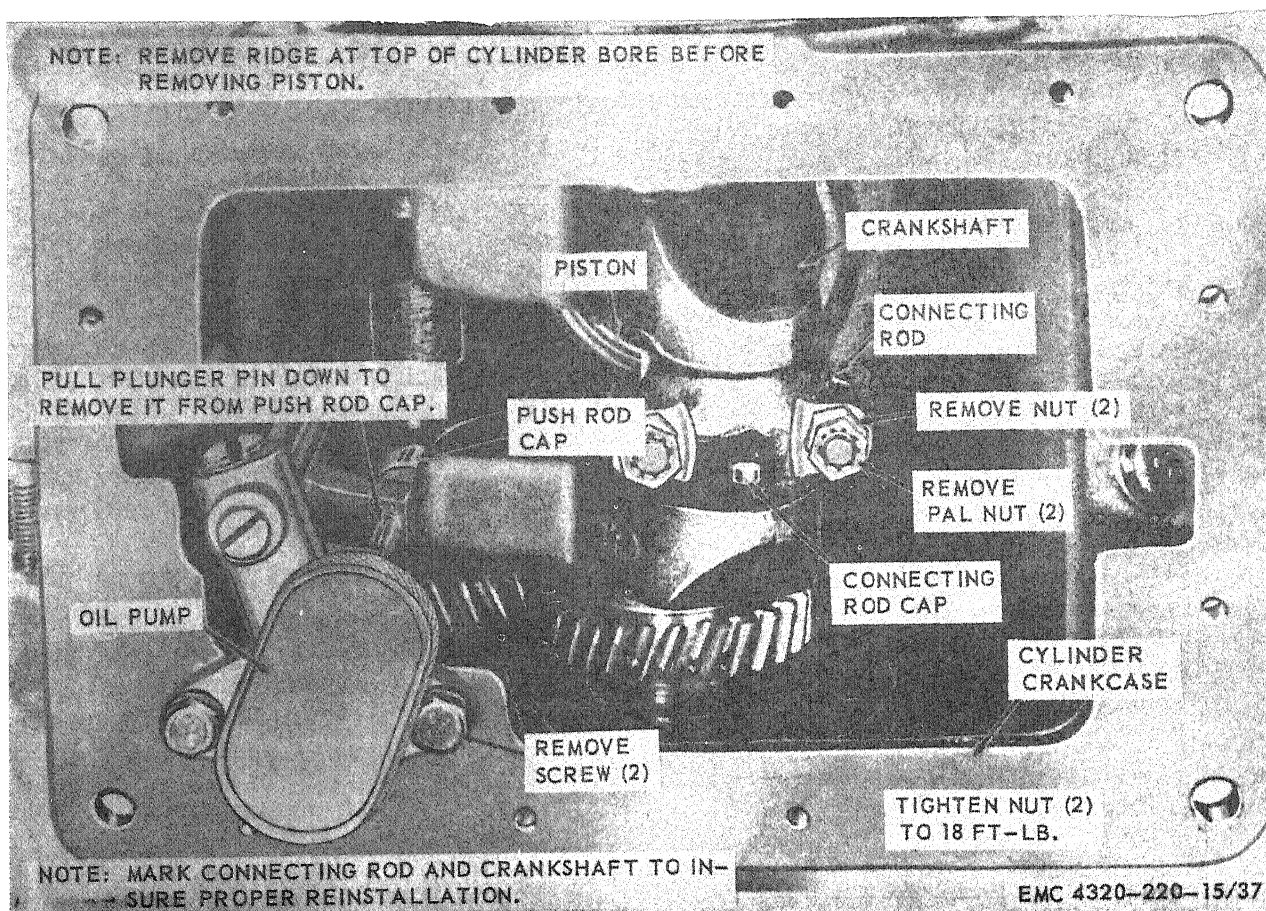
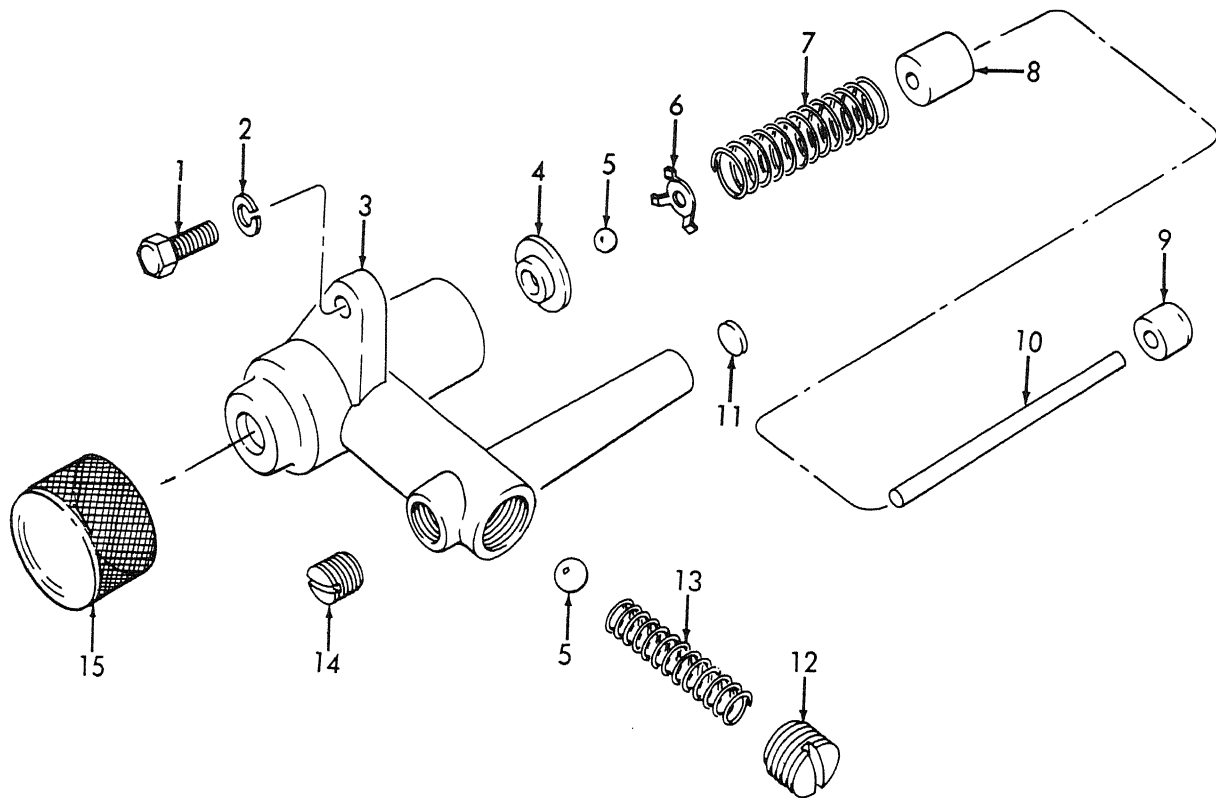


Figure 37. Oil pump and connecting rod and piston, removal and installation.



EMC 4320-220-15/38

- | | |
|---|-----------------------|
| 1 Bolt, machine, hex-hd, 1/4-20 x 4/8 in. (2 rqr) | 8 Plunger |
| 2 Washer, lock, 1/4 in. (2 rqr) | 9 Push rod cap |
| 3 Oil pump body | 10 Plunger pin |
| 4 Ball seat | 11 Expansion plug |
| 5 Bearing ball, 5/16 in. dia (2 rqr) | 12 Plug, pipe, 1/4-18 |
| 6 Check ball retainer | 13 Compression spring |
| 7 Compression spring | 14 Plug, pipe, 1/8-27 |
| | 15 Strainer |

Figure 38. Oil pump disassembly and reassembly.

Section VI. INTAKE AND EXHAUST VALVES

97. General

The valve system of the engine consists of 1 intake and 1 exhaust valve. Both valves are spring loaded and equipped with rotators to lessen the frequency of valve repair. The valve are accessible by removing the cylinder head and the valve inspection cover plate. Both valves operate in valve guides pressed into the cylinder crankcase. The valves and valve seat inserts are made of Stellite to resist burning. The function of the intake valve is to admit the fuel-air mixture to the combustion chamber while the exhaust valve controls the release of the exhaust gases from the combustion chamber.

98. Intake and Exhaust Valves

a. Remove and install the engine cylinder head (par. 66).

b. Remove and install the valve inspection cover plate (par. 67).

c. Remove the intake and exhaust valves and related parts as shown by figure 39.

d. Clean and inspect.

e. Reface the valves and grind seat inserts as follows:

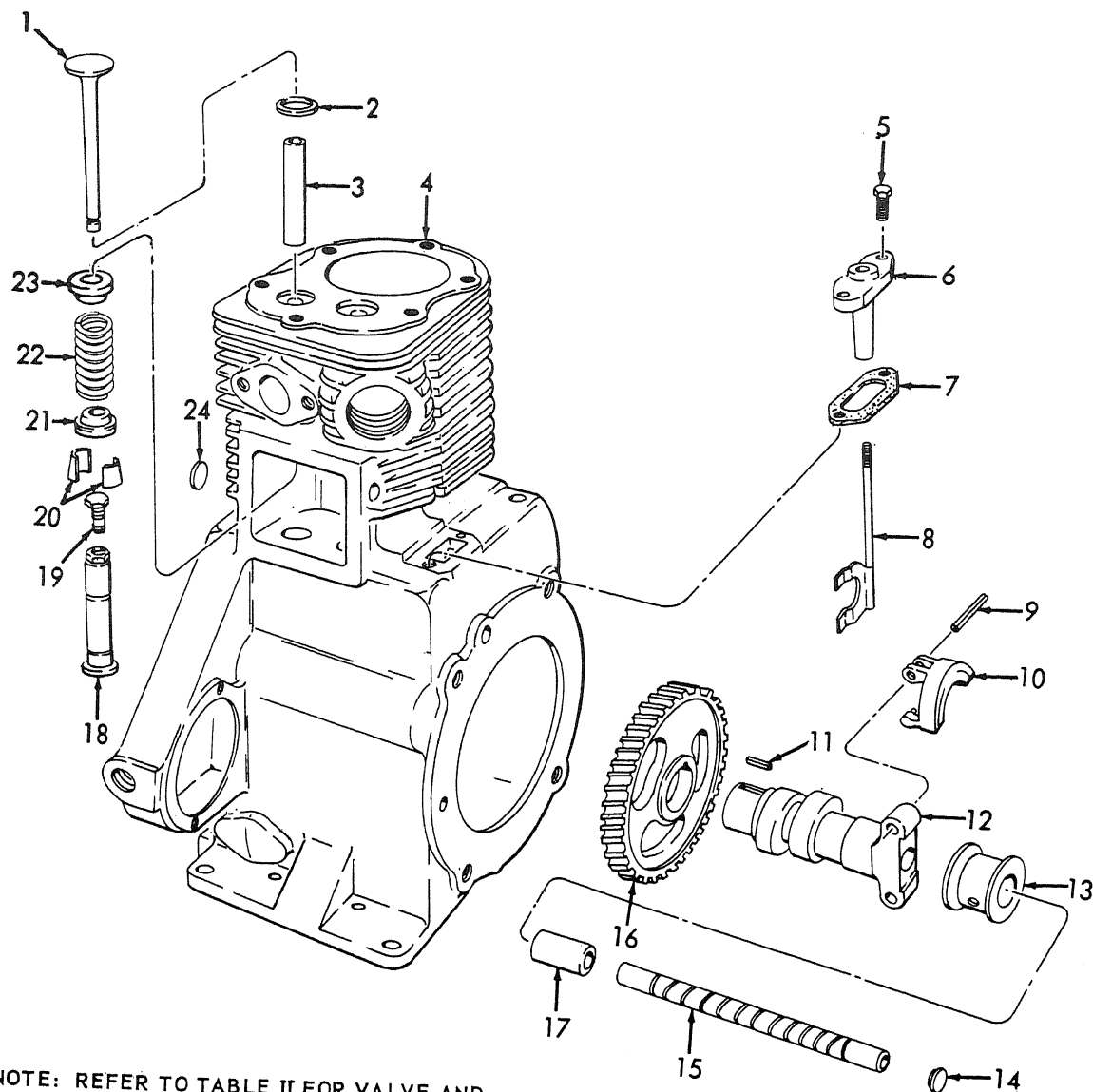
(1) Using a valve face grinder, reface the valves to an angle of 45°.

(2) Install the pilot of correct size in the valve stem bore of the valve guide. Reface the stone on the stone refacer to the angle of 45°. Place the grinder and stone assembly over the pilot in the valve stem bore of the valve guide and grind just enough to make a smooth seat.

(3) Inspect the valve seats for concentricity with a dial indicator.

f. Install the intake and exhaust valves and related parts as shown by figure 39.

g. Adjust the valve lifters as shown by figure 31.



NOTE: REFER TO TABLE II FOR VALVE AND CAMSHAFT SIZES, CLEARANCES, AND MAXIMUM ALLOWABLE WEAR.

OBSERVE TIMING MARKS ON GEARS TO INSURE PROPER REASSEMBLY.

EMC 4320-220-15/39

- 1 Valve (2 rqr)
- 2 Valve seat insert (2 rqr)
- 3 Valve stem guide (2 rqr)
- 4 Cylinder crankcase assembly
- 5 Screw, cap, hex-hd, 1/4-20 x 3/4 in. (2 rqr)
- 6 Support bracket
- 7 Governor yoke gasket

- 8 Governor yoke
- 9 Spring pin (2 rqr)
- 10 Governor flyweight (2 rqr)
- 11 Key, woodruff, No. 3
- 12 Camshaft
- 13 Sleeve bearing
- 14 Expansion plug

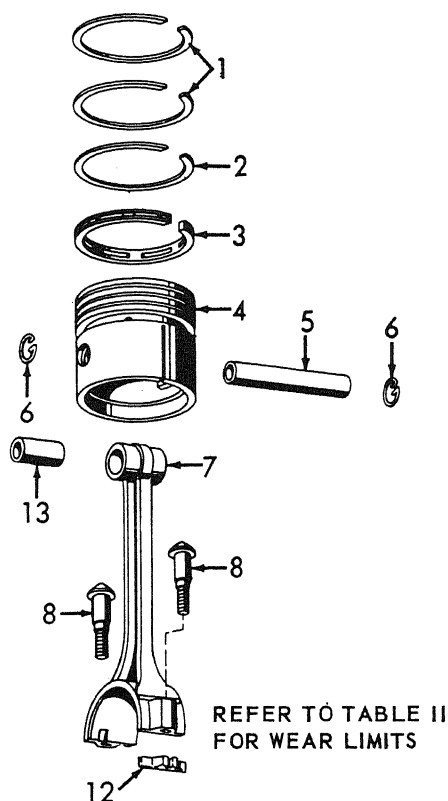
Figure 39. Valves and related parts, governor yoke, camshaft assembly and lifters, and governor flyweight assembly, disassembly and reassembly.

15 Camshaft support pin
16 Camshaft gear
17 Governor spacer
18 Valve lifter (2 rqr)
16 Adjusting screw (spec) (2 rqr)

20 Spring retainer lock (4 rqr)
21 Valve rotator (2 rqr)
22 Valve spring (2 rqr)
23 Spring centering seat
24 Expansion plug

Figure 39—Continued.

Section VII. PISTON AND CONNECTING ROD



1 Compression ring (2 rqr)
2 Scraper ring
3 Oil ring
4 Piston
5 Piston pin
6 Retaining ring (2 rqr)
7 Connecting rod
8 Bolt, shoulder, 5/16-24 x 1-3/4 in.
(2 rqr)
9 Rod cap
10 Nut, plain, hex, 5/16-24 (2 rqr)
11 Nut, stamped, 5/16-24 (2 rqr)
12 Shim
13 Sleeve bearing

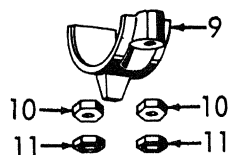
Figure 40—Continued.

99. General

The piston is an aluminum-alloy, four-ring piston. The piston has two compression rings, a scraper ring, and an oil control ring. The piston pin is of hollow steel and is held in place with a retaining ring at each end. The connecting rod is fitted with a sleeve bearing for the piston pin. The fit of the connecting rod on the crankshaft is governed by shims between the connecting rod and rod cap. Heat-treated screws with special washers retain the rod and cap.

100. Piston and Connecting Rod

- Remove and install the cylinder head (par. 66).
- Remove and install the engine base and oil pump (par. 96).
- Remove and install the connecting rod and piston as shown by figure 37.
- Disassemble and reassemble the connecting rod and piston as shown by figure 40.
- Clean, inspect, and repair.



EMC 4320-220-15/40

Figure 40. Connecting rod and piston, disassembly and reassembly.

Section VIII. CRANKSHAFT

101. General

The crankshaft is supported at both ends by cones and rollers. The outer race, or the cup of the bearing on the take off end of the engine, is supported in the bearing plate. Shims are installed between the bearing plate and the crankcase to provide the proper crankshaft end play. The bearing retainer plate is attached to the flywheel end of the engine crankcase.

102. Bearing Plate

- a. Remove and install the connecting rod and piston (par. 100).
- b. Remove and install the bearing plate as shown by figure 41.

103. Bearing Retainer Plate

- a. Remove and install the rope starting sheave (par. 64).
- b. Remove and install the flywheel (par. 65).
- c. Remove and install the flywheel shroud (par. 50).
- d. Remove and install the bearing retainer plate as shown by figure 42.
- e. Clean and inspect.

104. Crankshaft

- a. Remove and install the connecting rod and piston (par. 100).
- b. Remove, disassemble, reassemble, and install the crankshaft as shown by figure 43.
- c. Clean, inspect, and repair.

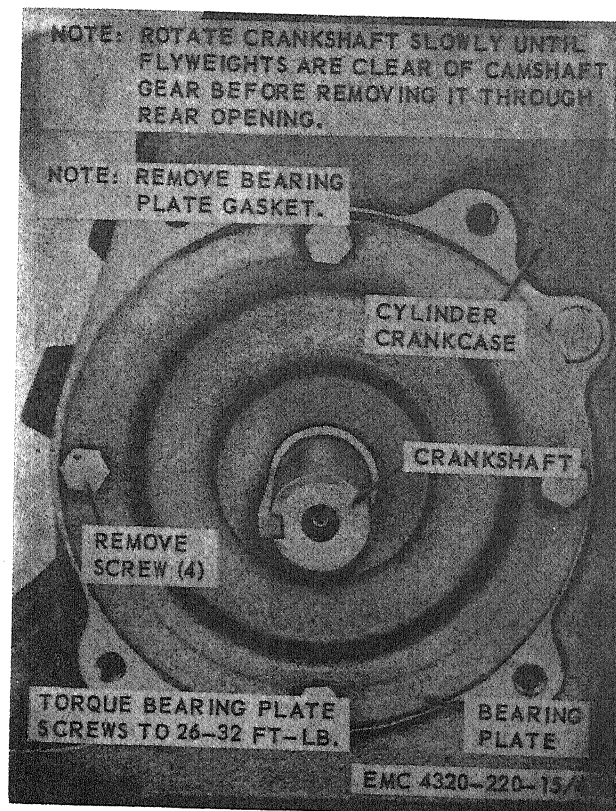


Figure 41. Bearing plate, removal and installation.

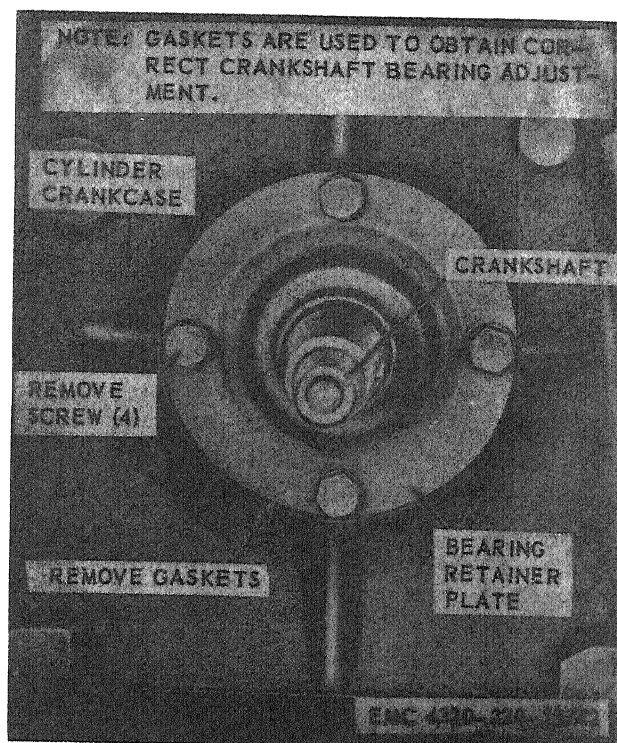
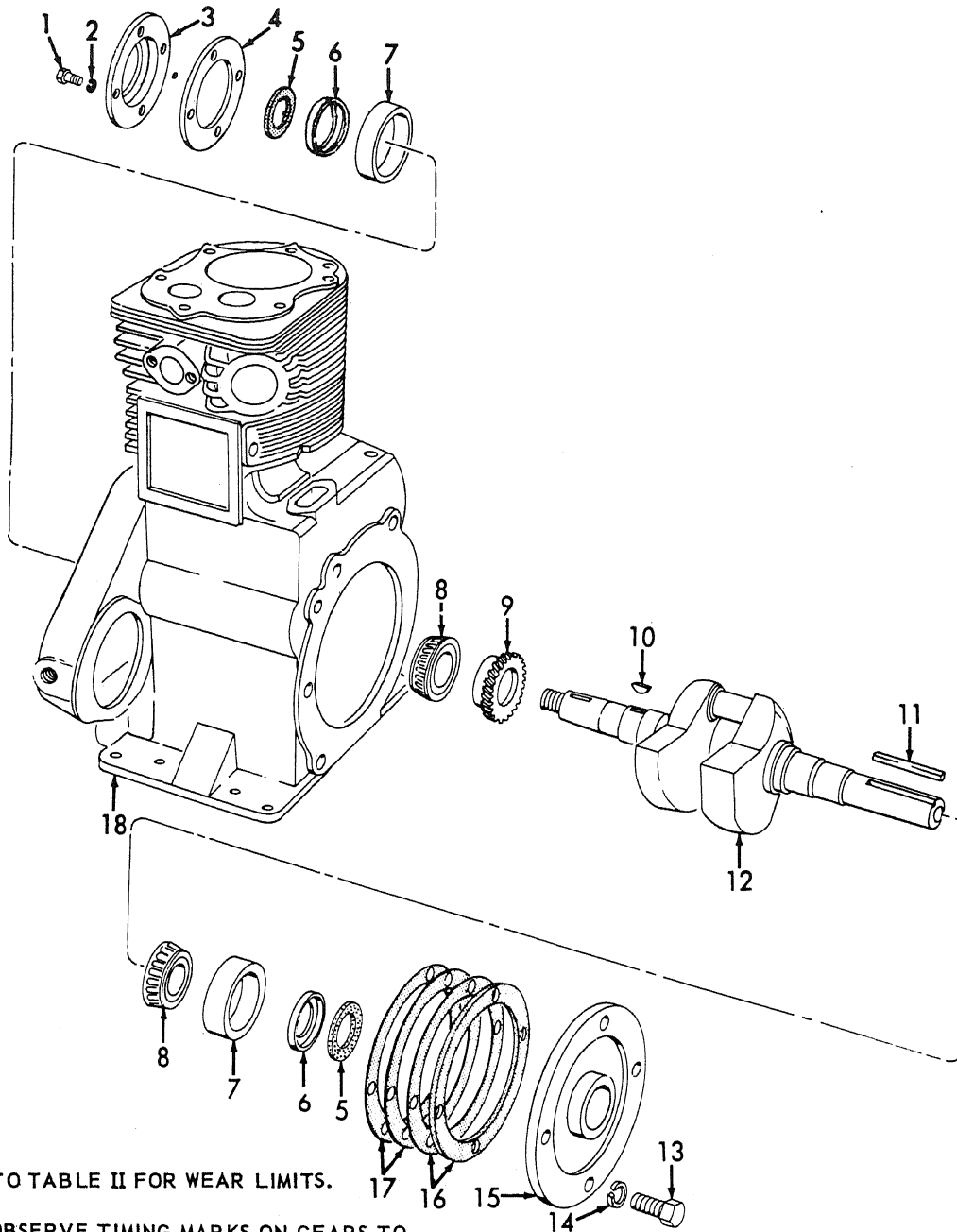


Figure 42. Bearing retainer plate removal and installation.



REFER TO TABLE II FOR WEAR LIMITS.

NOTE: OBSERVE TIMING MARKS ON GEARS TO INSURE PROPER REASSEMBLY.

EMC 4320-220-15/43

- 1 Bolt, machine, hex-hd, 5/16-18 x 3/4 in. (4 rqr)
- 2 Washer, lock, 5/16 in. (4 rqr)
- 3 Bearing retainer plate
- 4 Gasket
- 5 Oil seal retainer (2 rqr)
- 6 Gasket (2 rqr)
- 7 Roller bearing cup (2 rqr)
- 8 Cone and roller (2 rqr)
- 9 Crankshaft gear

- 10 Key, woodruff, No. 6
- 11 Key, machine, 1/4 x 1/4 x 2-1/2 in.
- 12 Crankshaft
- 13 Screw, cap, hex-hd, 3/8-18 x 1 in. (4 rqr)
- 14 Washer, lock, 3/8 in. (4 rqr)
- 15 Bearing plate
- 16 Gasket, 0.003 in.
- 17 Gasket, 0.006 in.
- 18 Cylinder crankcase

Figure 42 Crankshaft, removal, disassembly, reassembly, and installation.

Section IX. GOVERNOR YOKE, CAMSHAFT ASSEMBLY AND LIFTERS, AND GOVERNOR FLYWEIGHT ASSEMBLY

105. General

The camshaft, an alloy-steel forging, rotates on a pin driven into the crankcase and actuates the oil pump push rod. The mushroom-type lifters open and close the intake and exhaust valves. The governor flyweights, assembled on the camshaft, control the engine speed by varying the throttle opening as required by the load imposed upon the engine. The governor yoke actuates the governor control lever which in turn actuates the carburetor linkage.

106. Governor Yoke, Camshaft Assembly and Governor Flyweight Assembly

- a. Remove and install the governor linkage (par. 58).
- b. Remove and install the crankshaft (par. 104).
- c. Remove, disassemble, reassemble, and install the governor yoke, camshaft assembly and lifters, and governor flyweight assembly as shown by figure 39.
- d. Clean, inspect, and repair.

Section X. CYLINDER CRANKCASE

107. General

The cylinder crankcase is the main structural component of the complete engine. This one-piece casting houses such components as the engine oil pump, valves, Stellite valve seats, camshaft, and crankshaft. Other internal operating parts include an aluminum alloy piston and connecting rod, mushroom-type valve lifters, and centrifugal flyweight-type governor. Mounted to the cylinder crankcase are the cylinder head, engine base plate, a float-type carburetor, air cleaner, muffler, fuel tank and magneto.

108. Cylinder Crankcase

- a. Remove and install the carburetor (par. 56).
- d. Remove and install the rope starting sheave cover plate (par. 67).
- c. Remove and install the assembled fuel tank and bracket (par. 53).
- d. Remove and install the rope starting sheave (par. 64).
- e. Remove and install the flywheel (par. 65).
- f. Remove and install the oil fill plug and gage and oil drain plug (par. 55).
- g. Remove and install the governor control assembly and linkage (par. 58).
- h. Remove and install the crankcase breather line (par. 51).
- i. Remove and install the magneto (par. 61).
- j. Remove and install the bearing plate (par. 102).
- k. Remove and install the bearing retainer plate (par. 103).
- l. Remove and install the intake and exhaust valves and related parts (par. 98).
- m. Remove and install the crankshaft (par. 104).
- n. Remove and install the governor yoke, camshaft assembly and lifters, and governor flyweight assembly (par. 106).
- o. Clean and inspect.

APPENDIX I

REFERENCES

1. Dictionaries of Terms and Abbreviations

- AR 320-5 Dictionary of United States Army Terms
 AR 320-50 Authorized Abbreviations and Brevity Codes

2. Fire Protection

- TM 5-687 Repairs and Utilities; Fire Protection Equipment and Appliances; Inspections, Operations, and Preventive Maintenance
 TM 9-1799 Ordnance Maintenance: Fire Extinguishers

3. Lubrication

- LO 5-4320-220-15 Pump, Centrifugal: Gasoline Driven; Base Mtd; 2 In; 166 Gpm, 25 Ft Head (Barnes Model 10-MG) W/Wisconsin Engine Model MAENLD

4. Painting

- TB ENG 60 Preservation and Painting of Serviceable Corps of Engineers Equipment
 TM 9-2851 Painting Instructions for Field Use

5. Preventive Maintenance

- AR 700-38 Unsatisfactory Equipment Report
 AR 750-5 Maintenance Responsibilities and Shop Operations
 TM 5-505 Maintenance of Engineer Equipment

6. Publication Indexes

- DA Pam 108-1 Index of Army Motion Pictures, Film Strips, Slides, and Phono-Recordings
 DA Pam 310-1 Index of Administrative Publications
 DA Pam 310-2 Index of Blank Forms
 DA Pam 310-3 Index of Training Publications
 DA Pam 310-4 Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders
 DA Pam 310-5 Index of Graphic Training Aids and Devices
 DA Pam 310-25 Index of Supply Manuals—Corps of Engineers

7. Shipment and Limited Storage

- AR 743-505 Limited Storage of Engineers Mechanical Equipment
 TM 9-200 General Packaging Instructions for Ordnance General Supplies
 TM 38-230 Preservation, Packaging, and Packing of Military Supplies and Equipment

8. Supply Publications

- SM 10-1-C4-1 Petroleum, Petroleum-Base Products, and Related Material
 TM 4320-220-25P Organizational, Field and Depot Maintenance Repair Parts and Special Tool Lists
 Pump, Centrifugal: Gasoline Driven; Base Mtd; 2 In.; 166 Gpm, 25 Ft Head (Barnes Model 10-MG) Serial Number Range 1 Through 207, FSN 4320-820-0700

9. Training Aids

FM 5-25	Explosives and Demolition
FM 21-5	Military Training
FM 21-6	Techniques of Military Instruction
FM 21-30	Military Symbols

APPENDIX II

MAINTENANCE ALLOCATION CHART

1. General

This Appendix contains a Maintenance Allocation Chart listing all maintenance and repair operations authorized for the various echelons.

2. Maintenance

Maintenance is any action taken to keep material in a serviceable condition or to restore it to serviceability when it is unserviceable. Maintenance of material includes the following:

a. Service. To clean, to preserve, and to replenish fuel and lubricants.

b. Adjust. To regulate periodically to prevent malfunction.

c. Inspect. To verify serviceability and to detect incipient mechanical failure by scrutiny.

d. Test. To verify serviceability and to detect incipient mechanical failure by use of special equipment such as gages, meters, and so on.

e. Replace. To substitute serviceable assemblies, subassemblies, and parts for unserviceable components.

f. Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to, inspection, cleaning, preserving, adjusting, replacing, welding, riveting, and straightening.

g. Overhaul. To restore an item to *completely serviceable* condition as prescribed by serviceability standards developed and published by heads of technical services. This is accomplished through employment of the technique of "Inspect and Repair Only as Necessary" (IROAN). Maximum utilization of diagnostic and test equipment is combined with minimum disassembly of the term during the overhaul process.

3. Explanation of Columns

a. Functional Group. The functional group is a numerical set up on a functional basis

The applicable functional grouping indexes are taken from the Corps of Engineers Functional Grouping Indexes, and appear on the Maintenance Allocation Chart in their correct numerical sequence. These indexes are normally set up according to their proximity to each other and their function.

b. Components and Related Operation. This column contains the functional index grouping heading, subgroup headings, and a brief description of the part starting with the noun name. It also designates the operation to be performed such as service, adjust, inspect, test, replace, repair, and overhaul.

c. Echelon Maintenance.

Column 1. First Echelon: First echelon maintenance is that maintenance performed by the user or operator of the equipment, such as servicing, cleaning, lubricating, and limited adjustments. It also includes removal and replacement of items to accomplish servicing and lubricating.

Column 2. Second Echelon: Second echelon maintenance is that maintenance performed by trained personnel provided for that purpose in the using organization, such as replacement of all items in column 2, limited parts fabrication from bulk material, adjustments, and repair of assemblies, components, and end items that can be accomplished without extensive disassembly.

Column 3. Third Echelon: Third echelon maintenance is that maintenance performed by specially trained units in direct support of the using organization, such

as replacement of all items in columns 2 and 3, repair assemblies, components, and end items, and fabricate parts from bulk material.

Column 4. Fourth Echelon: Fourth echelon maintenance is that maintenance performed by units organized as semi-fixed or permanent shops to serve lower echelon maintenance within a geographical area, such as replacement of items in columns 2, 3, and 4, repair end items, overhaul assemblies, components, and fabricate general use common hardware and parts.

Column 5. Fifth Echelon: Fifth echelon maintenance is that maintenance authorized to overhaul assemblies, components, end items and replacement of all parts in column 2, 3, 4, and 5.

d. Symbol "X". The symbol "X" placed in the appropriate column indicates the lowest echelon responsible for performing that particular maintenance operation, but does not necessarily indicate repair parts will be stocked at that level.

e. Remarks. The remark column is used to explain why maintenance, that would normally be done at a lower echelon, is moved to a higher echelon because of some peculiarity in the construction of the end item.

MAINTENANCE ALLOCATION CHART

Functional group	Components and related operation	1	Echelons of maintenance					Remarks
			2	3	4	5		
01	ENGINE							
0100	ENGINE ASSEMBLY							
	Engine Assembly, Gasoline							
	Service -----	X						
	Inspect -----	X						
	Test -----		X	--	--	--		Compression
	Replace -----		X					
	Repair -----			X				
	Overhaul -----				X			
0101	CRANKCASE, BLOCK, CYLINDER HEAD							
	Head, Cylinder							
	Replace -----		X					
0102	CRANKSHAFT							
	Bearing Assembly, Crankshaft							
	Replace -----				X			
	Crankshaft Assembly							
	Replace -----				X			
0103	FLYWHEEL ASSEMBLY							
	Flywheel, Crankshaft							
	Replace -----		X					
0104	PISTONS, CONNECTING RODS							
	Piston, Internal Combustion Engine							
	Rod Assembly, Connecting							
	Replace -----				X			
	Repair -----				X			
0105.1	VALVES							
	Valve, Pin, Hollow and Insert							
	Replace -----				X			
	Repair -----				X			
	Springs, Locks, and Rotators							
	Replace -----				X			
0105.2	ROCKER ARMS, TAPPETS							
	Lifter, Valve							
	Adjust -----	--	X					
	Replace -----				X			
	Repair -----				X			
0105.3	CAMSHAFTS							
	Camshaft Assembly							
	Replace -----				X			
0105.5	TIMING GEARS							
	Gears, Helical Timing: Crankshaft and Camshaft							
	Replace -----	--	--		X			
0106.1	OIL PUMP							
	Body Assembly							
	Replace -----	--	--		X			
	Repair -----				X			
	Plunger, Oil Pump							
	Replace -----				X			
	Strainer, Oil Pump							
	Service -----				X	--	--	Clean

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
0106.5	CRANKCASE VENTILATION Line Assembly, Air Breather Replace -----			X	--	--	Fabricate
0106.6	OIL PAN, LINES, LEVEL GAGE Plug, Pipe: W/Gage Replace -----			X			
0108	MANIFOLDS Manifold, Intake Replace -----			X			
0111.1	HAND CRANKING DEVICES Rope Assembly, Starting Replace -----			X			
03	FUEL SYSTEM		X				
0301	CARBURETOR; FUEL INJECTOR Carburetor, Float: Adjust ----- Service ----- Replace -----			X X X	--	--	Clean and Install Bowl Gasket
0304	AIR CLEANER Air Cleaner, Intake Service -----		X				
0306	TANKS, LINES, FITTINGS Tank Assembly, Fuel Service ----- Tube, Fuel Replace ----- Strainer, Fuel Tank Service ----- Replace -----		X --	 X X	--	--	
0308	ENGINE SPEED GOVERNOR Yoke, Governor Replace ----- Flyweight Assembly Replace -----				X X		Fabricate
0308.4	GOVERNOR CONTROLS Control Assembly Replace ----- Repair -----		--	X X			
0309	FUEL FILTERS Strainer Assembly Service ----- Replace -----		X --	--	--	--	
0312	ACCELERATOR, THROTTLE OR CHOKE CONTROLS Rod, Throttle Lever Replace -----			X			Install Bowl and Gasket
04	EXHAUST SYSTEM						
0401	MUFFLER AND PIPES Muffler, Exhaust Replace -----			X			
05	COOLING SYSTEM						
0502	COWLING, DEFLECTORS, AIR DUCT, SHROUD Shroud, Flywheel Service -----	X	--	--	--	--	Clean Screen

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
06	ELECTRICAL SYSTEM (ENGINE AND VEHICULAR)						
0604.2	MAGNETO						
	Magneto, Ignition						
	Adjust -----			X			
	Replace -----			X			
	Repair -----			X	--	--	Install Kit
	Capacitor and Contact						
	Replace -----			X			
	Gear, Magneto Drive						
	Replace -----			X			
0604.2	IGNITION COIL: WIRING, SPARK PLUGS						
	Cable Assembly, Spark Plug						
	Replace -----			X			
	Spark Plug						
	Service -----			X			
	Adjust -----			X			
	Replace -----			X			
15	FRAME						
1501.1	PLATFORMS, SUPERSTRUCTURES, RAMPS, CATWALKS						
	Rails Base: Right and Left						
	Replace -----			X			
22	MISCELLANEOUS BODY, CHASSIS OR HULL, AND ACCESSORY ITEMS						
2210	DATA PLATES AND INSTRUCTION HOLDERS						
	Plate, Identification (C.O.E.)						
	Replace -----		--	--	X		
	Plate, Data and Instruction						
	Replace -----			X			
55	PUMPS (EXCLUDE ENGINE PUMPS)						
5500	PUMP ASSEMBLY						
	Pump, Centrifugal						
	Inspect -----		X				
	Service -----		X				
	Replace -----		--	X			
	Repair -----			X			
5501	VOLUTE, HOUSING						
	Body, Pump						
	Replace -----			X			
5502	IMPELLER, PUMP, CENTRIFUGAL ROTOR, DIAPHRAGM						
	Seal, Shaft, Assembly						
	Replace -----			X			
5504	DISCHARGE ASSEMBLY						
	Adapter, Pipe to Hose						
	Replace -----			X			
5504.2	SUCTION VALVE, SUCTION HEAD						
	Valve, Lift Check						
	Replace -----			X			
	Repair -----			X			

Functional group	Components and related operation	Echelons of maintenance					Remarks
		1	2	3	4	5	
5504.2	PRIMING DEVICES						
	Plug, Pipe						
	Replace -----		X				
5505	LUBRICATORS						
	Cup, Grease						
	Service -----		X				
	Replace -----			X			
76	FIRE FIGHTING EQUIPMENT						
7603	FIRE EXTINGUISHERS						
	Replace -----					X	

APPENDIX III

BASIC ISSUE ITEMS LIST

Section I. INTRODUCTION

1. General

Section II lists the accessories, tools, and publications required in 1st echelon maintenance and operation, initially issued with, or authorized for the centrifugal pump.

2. Explanation of Columns

a. Source Codes. The information provided in each column is as follows:

- (1) *Technical Services.* The basic number of the Technical Service assigned supply responsibility for the item is shown. Those spaces with no number shown are Corps of Engineers supply responsibility. Other Technical Service basic numbers are:

10—Quartermaster Corps
12—Adjutant-General's Corps

- (2) *Source.* The selection status and method of supply are indicated by the following code symbols:

- (a) P—applied to repair parts which are high mortality parts; procured by technical services, stocked in and supplied from the technical service depot system; and authorized for use at indicated maintenance echelons.

- (b) P1—applied to repair parts which are low mortality parts; procured by technical services, stocked only in and supplied from technical service key depots, and authorized for installation at indicated maintenance echelons.

- (3) *Maintenance.* The lowest maintenance echelon authorized to use, stock, install or manufacture the part is indicated the following code symbol:

Q—Organizational Maintenance
(1st and 2d Echelons)

b. Federal Stock Numbers. When a Federal stock number is available for a part, it will be shown in this column, and used for requisitioning purposes.

c. Description.

- (1) The item name and a brief description of the part are shown.
- (2) A five-digit Federal supply code for manufacturers and/or other technical services is shown in parentheses followed by the manufacturer's part number. This number will be used for requisitioning purposes when no Federal stock number is indicated in the Federal stock number Column.

Example; (0864586453.)

- (3) The letters GE, shown in parentheses immediately following the description, indicate General Engineer supply responsibility for the part.

d. Unit of Issue. Where no abbreviation is shown in this column, the unit of issue is "each".

e. Expendability. Those items classified as nonexpendable are indicated by letters "NX". Items not indicated by "NX" are expendable.

f. Quantity Authorized. This column lists the quantities of repair parts, accessories, tools, or publications authorized for issue to the equipment operator or crew as required.

g. Quantity Issued with Equipment. This column lists the quantities of repair parts, accessories, tools, or publications that are initially issued with each item of equipment. Those indicated by an asterisk are to be requisitioned through normal supply channels as required.

h. Illustrations. This column is subdivided into two columns which provide the following information:

- (1) *Figure number.* Provides the identifying number of the illustration.
- (2) *Item number.* Provides the referenced number for the part shown in the illustration.

3. Index to Federal Supply Code for Manufacturers

66289 ----- Wisconsin Motor Corps.

4. Comments and Suggestions

Suggestion and recommendations for changes to the Basic Issue Items List will be submitted on DA Form 2028 to The Commanding General, U. S. Army Engineer Maintenance Center, Corps of Engineers, ATTN: EMCM, P. O. Box 119, Columbus 16 Ohio. Direct communication is authorized.

APPENDIX III

Section II BASIC ISSUE ITEMS LIST

Technical service	Source codes			Federal stock no.	Description	Unit of issue	Expendability	Quantity authorized	Quantity issued with equipment	Illustration	
	Source	Maintenance	Recoverability							Fig	item
10	P	O		2990-618-6556	GROUP 01 ENGINE 0111.1 HAND CRANKING DEVICES STARTER ROPE, ENGINE, (66289) U-268 (GE). (Can be manufactured from CORD, SASH, stock No. 4020-241-8439 3 ft)			1	1		
	P	O		7520-559-9618	GROUP 26 ACCESSORIES, PUBLICA- TIONS, TEST EQUIPMENT AND TOOLS 2602.1 ACCESSORIES CASE, MAINTENANCE AND OPERATIONAL MANUAL: cotton duck, water repellent, mildew resistant			1	1		
	P	O		5120-264-3796	2602.2 COMMON TOOLS WRENCH, OPEN END, ADJUSTABLE: single head O to 1-5/16 in. jaw opening, 12 in. lg			1	(*)		
	P	O		5120-293-1602	WRENCH, SPANNER: 2602.4 PUBLICATIONS			1	(*)		
					DEPARTMENT OF THE ARMY OPERATOR, ORGANIZATIONAL, FIELD AND DEPOT MAINTENANCE MANUAL TM 5-4320-220-15			2	2		
					DEPARTMENT OF THE ARMY LUBRICATION ORDER LO 5-4320-220-15			1	1		
	P1	O			GROUP 76 FIRE FIGHTING EQUIPMENT 7603 FIRE EXTINGUISHERS EXTINGUISHER, FIRE, VAPORIZING LIQUID: 1/4 gal capacity, w/wall bracket (GE)			(See Note)			
	P1	O		4210-555-8837	EXTINGUISHER, FIRE, MONOBROMO- TRIFLUOROMETHANE: charged, hand shatterable cylinder, penetrating seal valve, stored pressure, w/bracket 2.75lb (HALON 1301) MIL-SPEC E52031 (GE) <i>Note.</i> Requisition CTC/CO ₂ extinguisher until depot stocks are exhausted.			1	1		

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Engine:

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Engine:

Backfires	39	28
Exhaust smoke excessive	37	27
Is hard to start or fails to start	34	27
Knocks	36	27
Lacks power	40	28
Misses or runs erratically	35	27
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BY ORDER OF THE SECRETARY OF THE ARMY:

Official:

R. V. LEE,
Major General, United States Army,
The Adjutant General

G. H. DECKER,
General, United States Army,
Chief of Staff.

Distribution:

Active Army:

DCSLOG (1)
USASA (2)
CNGB (1)
Tech Stf, DA (1) except
CofEngrs (3)
Army Maint Bd (1)
USCONARC (3)
USAARTYBD (2)
USAARMBD (2)
USAIB (2)
USARADB (2)
USAABELCTBD (2)
USAAVNBD (2)
ARADCOM (2)
ARADCOM, Rgn (2)
OS Maj Comd (5) except
USASETAF (2)
6th LOGCOM (10)
USAOMC (15)
MDW (1)
Armies (2)
Corps (2)
Div (2)
Engr Bde (1)
Svc Colleges (2)
Br Svc Sch (2) except
USAES (100)
USMA (2)
GENDEP (2) except
Atlanta GENDEP (6)
Schenectady GENDEP (6)
Utah GENDEP (6)
Memphis GENDEP (6)
Sharpe GENDEP (4)
Engr Sec, GENDEP (10)
Engr Dep (10) except
Marion Engr Dep (14)
Granite City Engr Dep (14)
USA Trans Tml Comd (2)
Army Tml (1)
OSA (2)
Dist Engr (2) except
Buffalo Dist Engr (1)
Chicago Dist Engr (1)
Detroit Dist Engr (1)
Alaska Dist Engr (1)

Los Angeles Dist Engr (1)
New Orleans Dist Engr (1)
New York Dist Engr (1)
Louisville Dist Engr (1)
Pittsburgh Dist Engr (1)
San Francisco Dist Engr (1)
Omaha Dist Engr (1)
Seattle Dist Engr (1)
Kansas City Dist Engr (1)
Baltimore Dist Engr (1)
Fort Worth Dist Engr (1)
Philadelphia Dist Engr (1)
Eastern Dist Engr (1)
Rock Island Dist Engr (1)
St. Louis Dist Engr (1)
St. Paul Dist Engr (1)
Div Engr (2) except
Lower Miss Valley Div Engr (none)
North Central Div Engr (none)
Engr Fld Maint Shops (2)
USAERDL (3)
Engr Cen (5)
AMS (3)
Chicago Proc Ofc (10)
EMC (26)
ESCO (St. Louis) (10)
Fld Comd, DASA (8)
USACOMZEUR (2)
USAREUR Engr Sup Con Agcy (10)
MAAG (1)
USA Corps (1)
JBUSMC (1)
Units org under fol TOE:
5-48 (2) 5-500 (EA,EB,GJ) (2)
5-129 (2) 6-630 (2)
5-214 (2) 9-47 (2)
5-225 (2) 9-87 (2)
5-226 (2) 9-510 (AB) (2)
5-237 (5) 29-52 (1)
5-262 (5) 29-56 (2)
5-267 (1) 29-57 (2)
5-278 (5) 29-307 (2)
5-279 (2) 39-51 (2)
5-376 (2) 55-225 (2)
5-377 (2) 55-227 (2)

NG State AG (3).

USAR: Same as Active Army except allowance is one copy to each unit.

For explanation of abbreviations used, see AR 320-50.